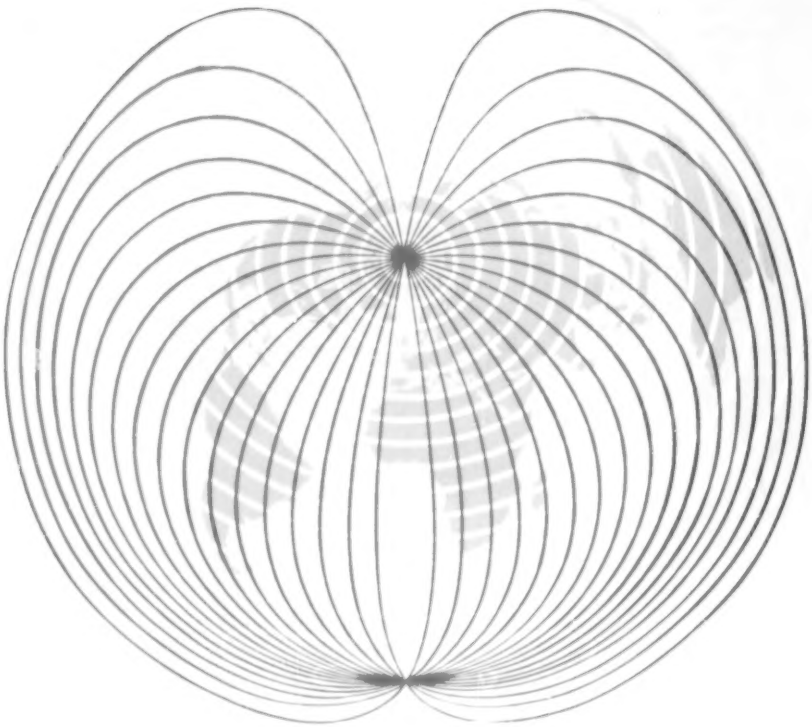
Wireless World

JANUARY 1954 · TWO SHILLINGS



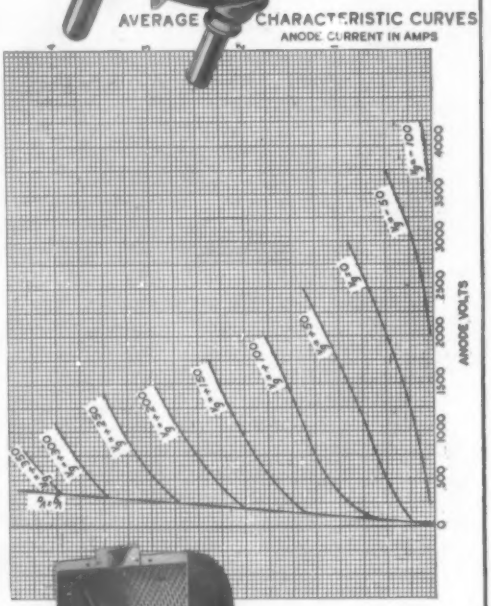
RADIO, TELEVISION AND ELECTRONICS

DATA for the Designers File

If your field of design covers R.F. Heating it is highly probable that there is a place in your specification for the Ediswan E.S. 833.

The ES.833 is a high mu triode particularly suitable for use as an R.F. Power Amplifier, Oscillator or Class B modulator.

The anode and grid connections are brought out at the top and are taken through metal to glass seals to heavy current terminals. As a result of this construction the valve is exceptionally efficient at higher radio frequencies and may be operated under class 'C' CW conditions at a maximum input of 2kW at frequencies up to 30Mcs. At reduced input rating it is possible to operate the valve as high as 75Mcs.



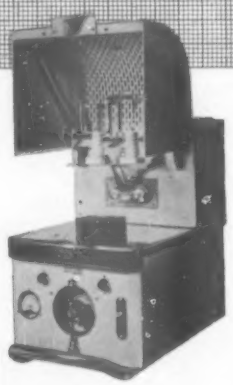
RATING

Filament Voltage (volts)	V_f	10.0
Filament Current (amps)	I_f	10.0
Maximum Anode Voltage (volts)	$V_{a\,(max)}$	3,000
Maximum Anode Dissipation (watts)	$W_{a\,(max)}$	300
Amplification Factor	μ	35
Maximum Operating Frequency at full rating		*30 Mc/s

* *At higher frequencies the maximum permissible anode voltages and inputs must be reduced.*

'Radyne' Pre-Heating Equipment incorporates the E.S. 833

This small dielectric oven will fully plasticise 6 ozs. of plastic material in one minute. The output of the equipment is approximately 600W. at a frequency of approximately 37 m/cs.



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Those who have followed the growth of high quality reproduction in recent years may wonder how it is possible to improve still further the amplifier part of the system. Yet, like its predecessor, the QUAD II introduces entirely new features of importance to the final objective—features anticipating trends in design of both amplifier and associated equipment.

Engineers will readily appreciate among the many salient points of design of this amplifier, the complete stability under all load conditions. They will delight too in the unique low noise pickup matching system and in the new wide range filter developments.

The gramophone enthusiast will be pleased to find that his moving coil pickup no longer requires a transformer; that each of the seven playback characteristics is accurately provided at the touch of a button; that the logical system of filter control gives him low distortion without the sacrifice of correct musical balance.

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A booklet describing the **QUAD II** *is available on request from*

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for more efficient VHF communications equipment

The introduction of this group of double tetrodes marks an outstanding advance in power and driver valves for V.H.F. mobile and fixed communications equipments. The principal design feature of all three valves is the use of a common cathode and common screen-grid for their two tetrode sections. As a result, they are characterised by high efficiencies, high power gain and heater economy. These characteristics permit the use of small driver valves and lead to low power consumption, thus enabling considerable savings in space to be made.

Other important features of these double tetrodes include built-in neutralising capacitors, which enable circuitry to be simplified; and low inter-electrode capacitances, which allow wide tuning ranges and high circuit efficiencies.

Of special interest to designers of battery-operated equipments is the fact that whilst optimum performance of these double tetrodes is obtained with a heater supply of nominally 6.3V, good operating characteristics are maintained if, for any reason, the valves are slightly under-run for short periods. Full technical details of these and other types in the Mullard range of valves for communications equipments will be gladly supplied on request.

PRINCIPAL CHARACTERISTICS

TYPE	DESCRIPTION	BASE	HEATER		LIMITING VALUES				
			SERIES	PARALLEL	Va max (V)	pa max (W)	Vg2 max (V)	pg2 max (W)	Ik max (mA)
QQV03-10	Miniature R.F. Power Double Tetrode	B9A	12 0.4	6.0V 0.8A	400	2×5	250	2×1.5	2×40
QQV03-20	R.F. Power Double Tetrode	B7A	12.6 0.65	6.3V 1.3A	600	2×10	250	2×1.5	2×55
QQV06-40	R.F. Power Double Tetrode	B7A	12.6 0.9	6.3V 1.8A	600	2×20	250	2×3	2×120

Mullard

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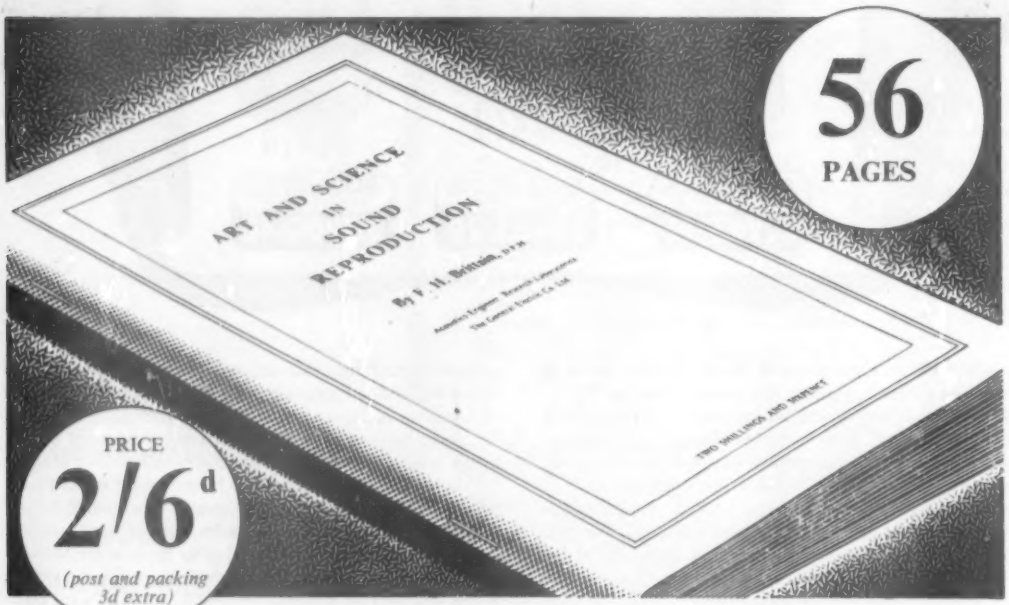

A book for the discriminating listener to sound recordings and broadcasts. Every enthusiast of High Quality sound reproduction should possess this book, which includes a special foreword by the Author on the Art of Listening. Its 56 pages include valuable and detailed information on the intelligent use of the controls to suit all circumstances; full circuit data on a new comprehensive pre-amplifier, and also on the famous Osram Valve Negative Feed-back Quality Amplifiers.

Contents include :-

The Art of listening · The Loudspeaker Amplifiers for the high quality reproduction of sound · Design factors in high fidelity amplifiers Circuit and constructional details on 6, 12, 14, 20 and 30 watt amplifiers · The design of the pre-amplifier and tone control · Notes on feeder units · Using the G.E.C. F.R. metal cone loudspeaker.

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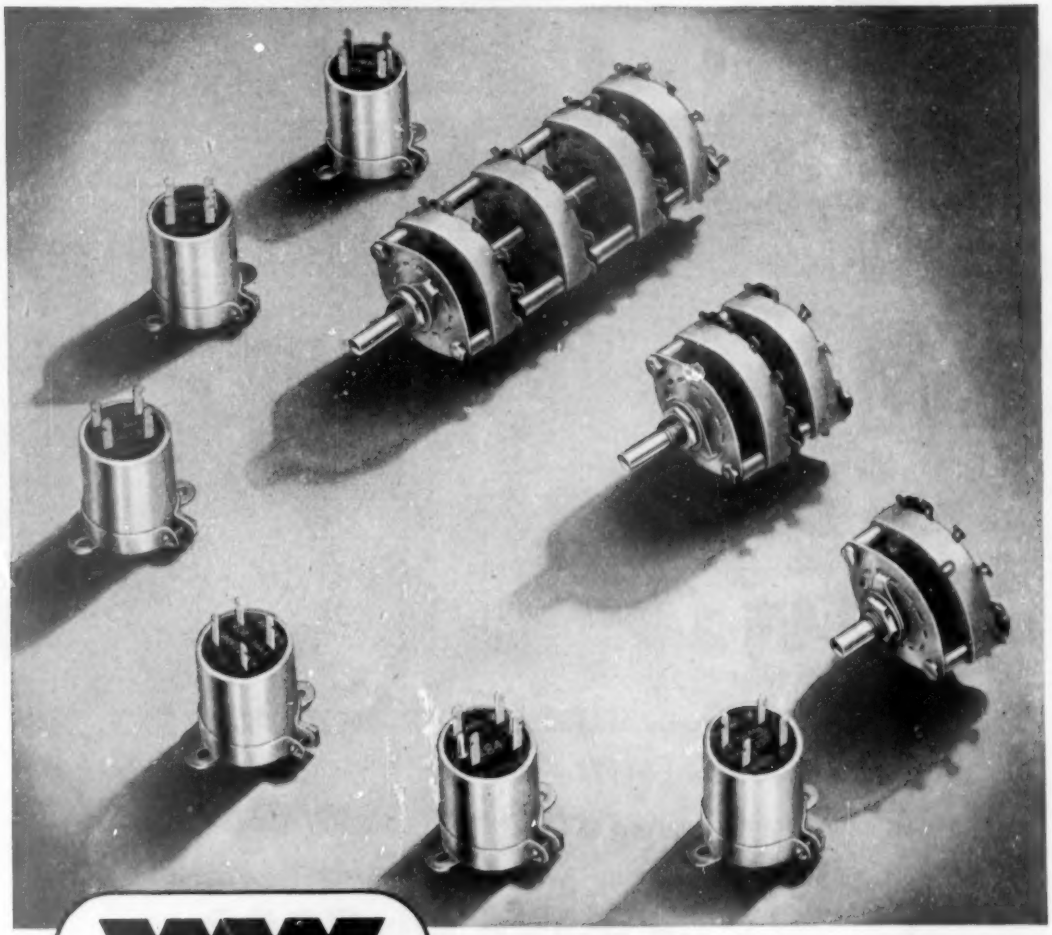

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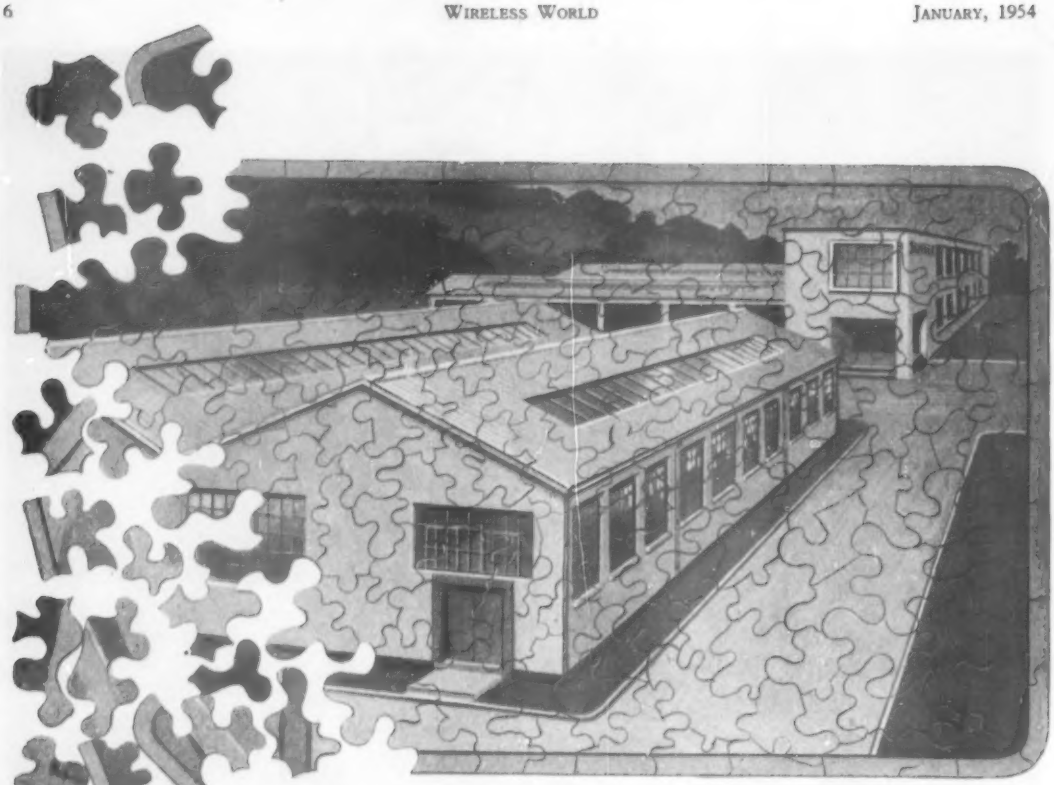

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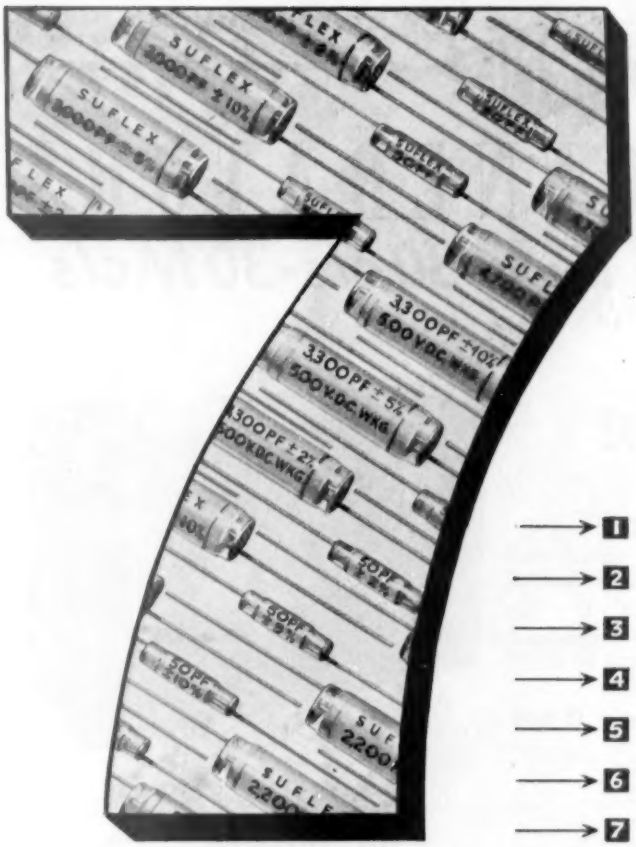

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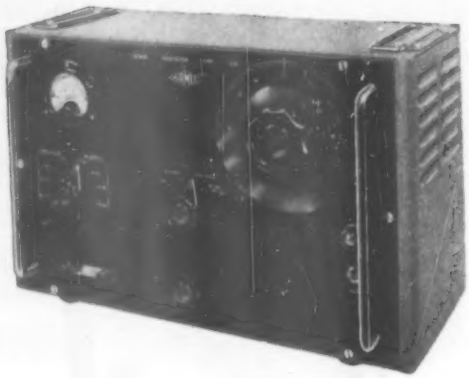
SIGNAL GENERATORS

for the frequency range 30 c/s-30 Mc/s

L.F. SIGNAL GENERATOR TYPE 702



- **Frequency Range :** 30 c/s-30 kc/s.
- **Stability :** ± 0.05% ± 0.5 c/s.
- **Output :** A screened and balanced transformer enables balanced, unbalanced and fully floating outputs to be obtained.
- **Attenuator :** A 600 ohm constant impedance attenuator provides steps of 20, 40 and 60 db of attenuation under all output conditions.
- **Output Level :** 100 mW into 600 ohms or 15 volts open circuit.

H.F. SIGNAL GENERATOR TYPE 701

- **Frequency Range :** 30 kc/s-30 Mc/s.
- **Output Level :** Constant to within 1 db over entire frequency range.
- **Output Impedance :** 75 ohms ± 10 ohms on the 0 db step of the attenuator and 75 ohms ± 3 ohms on all other settings.
- **Attenuators :** A slide wire and step attenuator calibrated both in db and volts open circuit enable the output to be reduced to 1 microvolt.
- **High Output :** A signal voltage of from 5-20 volts is available from a high impedance output socket.

The L.F. Signal Generator Type 702 may be connected to the H.F. Signal Generator Type 701, to enable signals over the complete frequency range 30 c/s to 30 Mc/s to be obtained from the output plug of the latter instrument.

Full details of these or any other Airmec instruments will be forwarded gladly upon request.

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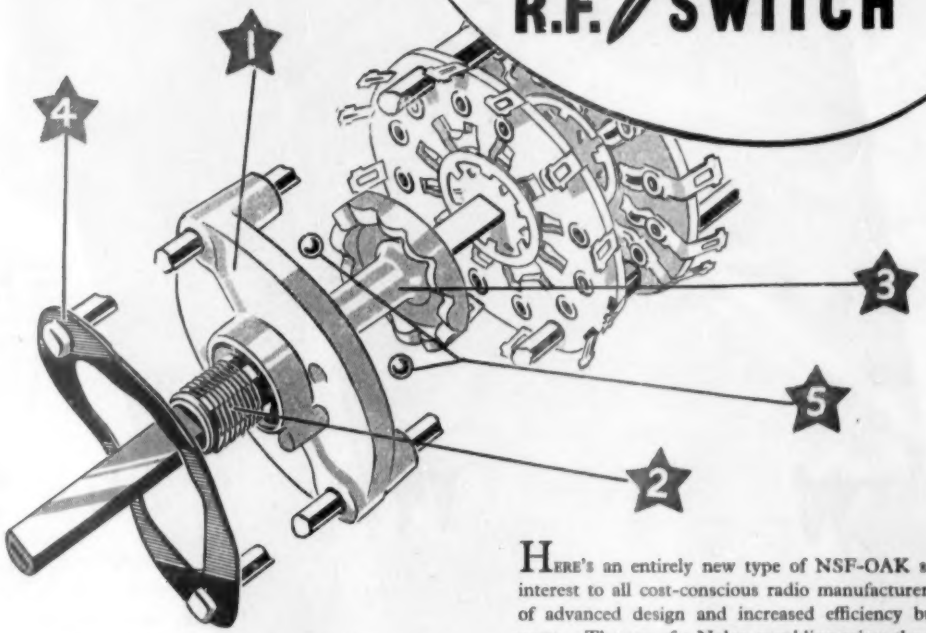
NOW! WORLD'S FIRST Nylon R.F. SWITCH



1 **Front Plate and first spacer.** One-piece Nylon moulding.

2 **Bush.** Integrally moulded in front plate.

3 **Spindle and Index Plate.** One-piece Nylon with moulded-in drive shaft.

4 **Index Spring.** Full diameter — therefore lightly stressed.

5 **Steel Indexing Balls.**

Consistently positive and smoother action for both 30° and 60° indexing.

HERE'S an entirely new type of NSF-OAK switch of interest to all cost-conscious radio manufacturers. It is of advanced design and increased efficiency but fewer parts. The use of a Nylon moulding raises the standard of performance, but in addition creates a stronger, simpler and cheaper switch. Nylon possesses characteristics pre-eminently suited to meet exacting electronic requirements. It is light, stable, very strong, self-lubricating and has low surface tension for long life and high insulation resistance even under extremely humid conditions.

The Nylon Type NDH as illustrated is available for immediate delivery and samples can be supplied for prototype use and test purposes on request. The miniature Nylon Type NDM will be available shortly.

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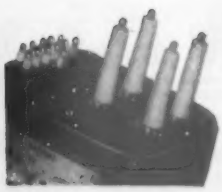
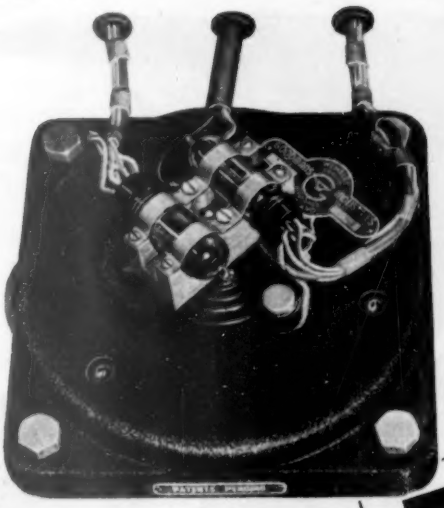
The firm with the one-track mind

There's no doubt that Parmeko *could* make an excellent electric light bulb, or a battery charger, or even an electronic brain, or anything with impulse and kick; but 25 years ago they decided to make only transformers and to try to make them better than anyone else. It may have been advice from the founder's grandfather . . . " Jack of all trades . . . ". It may have been a premonition that building and budgetary difficulties would be greater a quarter of a century hence. Or it may have been decided that by concentrating all capital, plant, brains, and experience on *one* set of problems only—those connected with transformers—there would be a better chance of success than if the effort were spread over several projects. The fact is that today Parmeko are still talking, planning, creating, designing, and dreaming . . . transformers. Forgive them then if they think their transformers good: their opinion is shared by most of the manufacturers of electronic and electrical equipment.



PARMEKO *of* **LEICESTER**

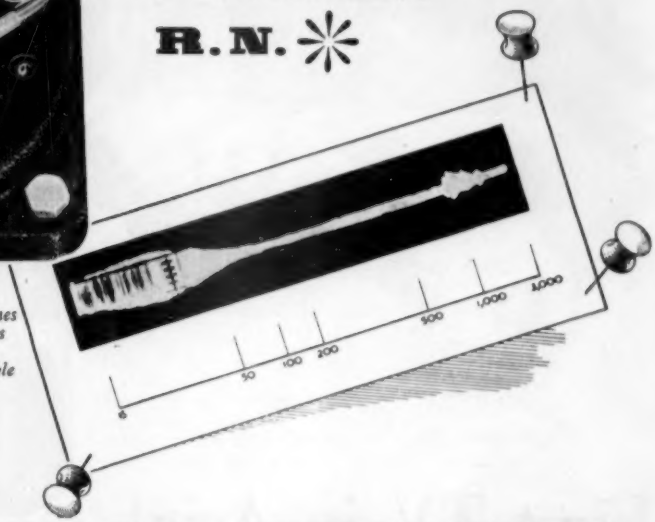
MAKERS OF TRANSFORMERS *for the Electronic and Electrical Industries*



BRIMAR

Pin down

R.N. ✳



Illustrations by courtesy of Standard Telephones and Cables Limited who say, "These vibrators have been chosen as they give a faithful reproduction of the input wave form and enable high accelerations at any frequency to be obtained."

with GOODMANS VIBRATORS

✳ RESONANCE NOISE describes a particular factor in a valve which can very seriously impair its otherwise good characteristics. Only when "R.N." is negligible can a valve operate strictly according to its published "curve" and data.

Complete investigation of this phenomenon is only possible by subjecting the valve to *controlled* vibration throughout a wide frequency range. If the valve is operated in a Class A circuit, and the A.C. noise voltage appearing at the anode of the valve is presented on an oscilloscope, a resonance diagram against input frequency can be obtained. By this means it is possible to excite the valve in the range of frequencies 20 to 10,000 c/s, and the resonance noise performance checked. By the use of a twin mounting as illustrated, comparisons of valves can be made under identical conditions.

Just another of the wide applications of Goodmans Vibration Generators. Perhaps "controlled vibration" can serve you also.

The range includes models developing a force of ± 300 lbs. to the midget model with a force output of ± 2 lbs. for optical-cell research and hairspring torque testing etc. Full technical data available from "Vibration Division W"

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The list of countries installing RCA TV transmitters is growing steadily: Brazil, Canada, Cuba, Dominican Republic, Hawaii, Italy, Japan, Mexico, the Philippines, Thailand, Venezuela . . . with still others now planning video for their people.

Abroad, as in the U.S.A., where it is the preferred system, RCA has everything for television . . . from camera to antenna, from studio to transmitter to receiver. To date there are *170* RCA-equipped TV stations in the U.S.A. . . . and *22* in other countries. RCA also provides the service of distributors and companies long versed in the electronic needs of their countries.

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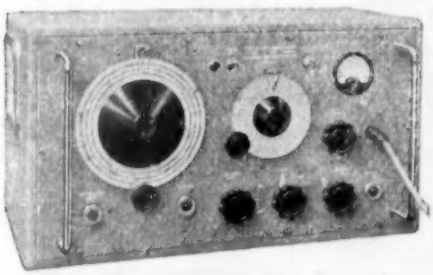
Marconi U.H.F Signal Generator Type TF 762C

Signal Generators for the 300-900 Mc/s Band

In these U.H.F. Signal Generators more than five feet of continuous scale provides exceptional discrimination and accuracy over the entire range.

		TF 762C	TF 762C/2
FREQUENCY	*Range :*	300 *to* 600 *Mc/s*	450 *to* 900 *Mc/s*
	Direct Discrimination :	0.5 *Mc/s*	1 *Mc/s*
	Absolute Accuracy :	±1%	±1%
OUTPUT	*Source Impedance :*	52 *or* 75 *ohms as ordered*	52 *ohms only*
	Maximum Output :	1 *mW*	0.8 *mW*
	Attenuation Range :	100 *db*	110 *db*



MODULATION

INTERNAL : *(a) 50-50 squarewave at approx. 1,000 c/s accompanied by squarewave synchronising signal of approx. 150 volts amplitude at a high source impedance.*

(b) Nominally 80-μsec pulse at 1,000 c/s accompanied by squarewave synchronising signal as above.

EXTERNAL : *Provision is made for external squarewave or pulse modulation.*

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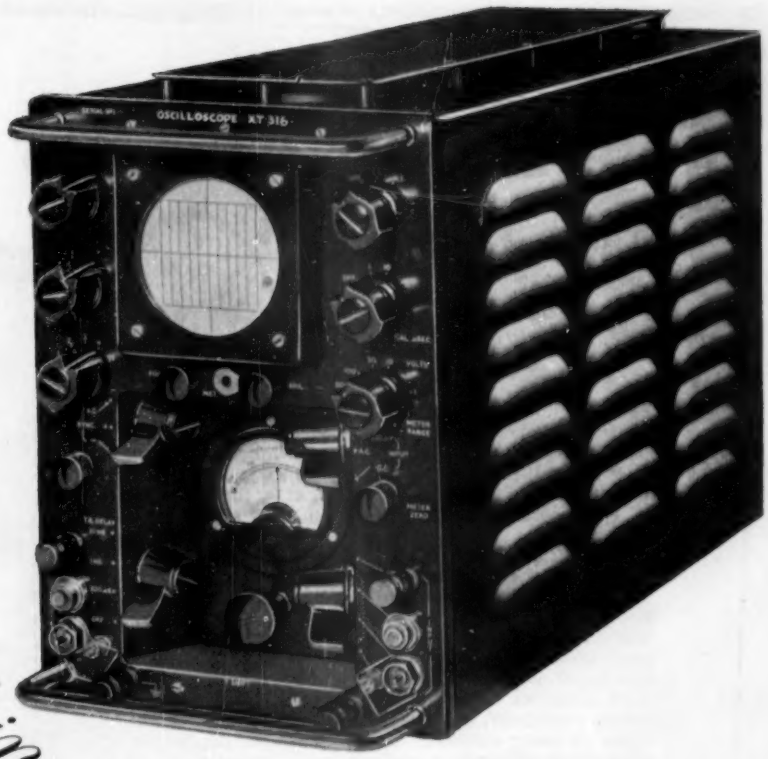

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Outstanding features :

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Brilliantly designed at the Radar Research Establishment, this new oscilloscope incorporates the latest advances in circuit technique and construction. It is eminently suited to the display and accurate measurement of the velocity and amplitude of pulse waveforms encountered in radar and communications equipment. **£145**

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INDEPENDENT SIDEBAND RECEIVER

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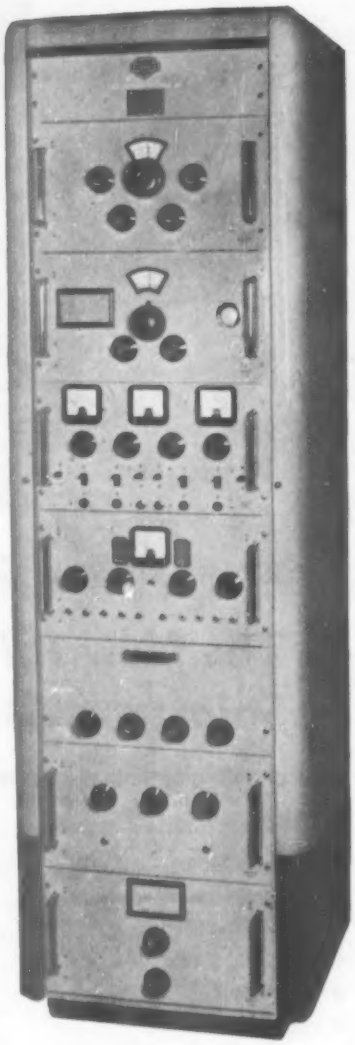

THIS new Independent Sideband Receiver type GFR 552 is designed for operation on long-distance, point-to-point, short-wave radio links forming part of the international trunk network. On independent sideband working, the GFR 552 provides facilities for the reception of two single sideband signals, each 6 kc/s wide, one above and one below the frequency of a reduced-level pilot carrier. Each sideband will accommodate either two 3 kc/s wide telephony channels, or several voice frequency telegraph channels. The GFR 552 may also be used for reception of single sideband or double sideband transmission. In the case of the second application this receiver offers two advantages: firstly, the absence of non-linear distortion which occurs in normal d.s.b. receivers when signals are subjected to selective fading conditions; and, secondly, the ability to select upper or lower sideband for demodulation, dependent upon which is freer from adjacent channel interference.

The circuit and chassis layout of the GFR 552 closely follows that of the Mullard Receiver GFR 551, which was based on a British Post Office design (Receiver, Radio No. 22).

Special features of the GFR 552 include a high order of oscillator stability and freedom from cross-modulation through which cross-talk between channels or inter-modulation between wanted and unwanted signals might occur. A brief technical summary is given below. More detailed information supplied on request.

FREQUENCY RANGE—*4-30 Mc/s.*
NOISE FACTOR—*better than 7 dB over the band.*
SIGNAL TO NOISE RATIO—*25 dB for 4 microvolts peak sideband input over the band.*
SELECTIVITY—*The response is flat within 2 dB for sideband frequencies between 100 c/s and 6000 c/s. At 10 kc/s from the carrier frequency the response is −60 dB relative to the pass band.*
A.F.C.—*The a.f.c. system operates effectively with a pilot carrier level of −26 dB relative to 1 microvolt (which corresponds to a peak sideband level of 1 microvolt and a signal to noise ratio of 15 dB).*
NON-LINEAR DISTORTION—*Third order intermodulation products which might result in cross talk between sidebands do not exceed −50 dB relative to the sideband levels.*
OUTPUT—*Variable up to +14 dB relative to 1 mW into 600 ohms.*

Mullard

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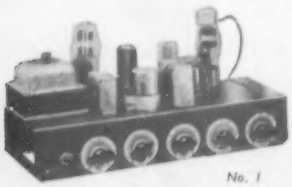
You may have already extended your record reproducer to include the now firmly established L.P. Records. You may be considering doing so. In either case, for real high fidelity at modest cost, it will pay you to consult us. Our aim is not just to sell you equipment *but to save you money and to ensure that you get the apparatus most suited to your needs.* **Discuss your problem with our Chief Engineer (available daily including Saturdays 11 a.m. to 6 p.m.). Or write enclosing 2½d. stamp. This Technical Guidance Service will cost you nothing and save you pounds.**
NOTE: Regarding Pick-up heads to take standard or miniature thorns for 78 r.p.m., these can be supplied with any of the single-record Gram Units or Auto-changers sold by us, if desired.



No. 1

No. 1 "SYMPHONY" AMPLIFIER is a 3-channel 5-watt Gram/Radio Amplifier with astonishingly flexible tone-control. You can lift the treble, the bass, or—and here is the unique feature—the middle frequencies to suit your own ear characteristics and the record or radio programme being heard. It is thus possible to arrange the frequency-response of the amplifier to a curve equal and opposite to the resultant curve of the other items in the chain so that what finally registers in the brain is as per original. This flexibility of control is far more important than mere nominal linear response of the amplifier, as the pick-up, speaker, etc., are not linear. Independent Scratch-Cut is also fitted and special negative-feedback circuit employed. The amplifier can accommodate a wide variety of records from old 78's to new L.P.'s. Input is for all types of pick-up of 0.2v. output or more and there is full provision (and power) for Radio Tuner. It is available to match 2/3 or 15 ohms speakers. Price: **10 gns.** (carriage 5/-). Fitted in Portable Steel Cabinet 35/- extra.

GARRARD 3-SPEED GRAM UNIT MODEL "T." With turnover Magnetic Pick-up Head or Turnover Astatic Crystal Head, **£10**, post and pack., 2/6.

MODEL "TA," as above, but fitted with the latest Radio Show High-Fidelity Acos HGP35 Pick-up Heads (one for Std. and one for L.P.). Price **£12/3/9**, post and pack. 2/6. Heads only, 43/- each, post 1/-.

Model "TB," as above, but with two separate Decca XMS Heads, **£13/7/6**, post and pack., 2/6. Or with two separate Acos GP19 Mk. 2 Heads, **£12/10/-**. Or with Garrard Head for fibres (78) and Acos GP19 Mk. 2 for L.P., **£12/5/-**, post 2/6.

GARRARD 3-SPEED AUTO-CHANGERS, Model RC80, plays up to ten records 7in., 10in. or 12in. at 78, 45 and 33⅓ r.p.m. Stylus pressure on L.P. 10 grammes (adjustable). New ultra-sensitive auto-trip mechanism and heavy loaded turntable to eliminate "wow." Price **£14/2/6** or with Garrard Magnetic or Astatic Crystal Turnover Pick-up Head, **£16/2/6**. With two separate Acos Hi-fi Heads, **£18/2/6**. With two separate Decca XMS Heads, **£19/7/6**. Carriage 5/-. Optional Extras: 45 r.p.m. Auto Centre Spindle, **20/9**; A.C./D.C. Operation **£7/14/-**. Fitting in de luxe rexine-covered Portable Cabinet, **£5**. Pick-up Head to take Fibre Needles, **25/-** to **35/-**.

GARRARD 3-SPEED AUTO-CHANGERS, MODEL RC90 in de luxe rexine-covered Portable Case, **£23/1/-**. Or fitted with Garrard Magnetic Turnover Head, **£25/3/5**. Or fitted with two separate Acos high-fidelity HGP35 Heads, **£27/7/-**. Carriage in all cases 7/6.

ABOVE GARRARD UNITS are for A.C. Mains but are also available at extra cost as follows: 6v. D.C. **90/-**; 12v. D.C. **90/-**; 200-250v. A.C./D.C. **153/-**.

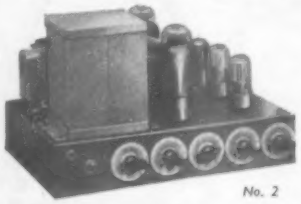
VIBRATOR POWER UNITS to enable the use of any modern A.C. Record Player together with one of our Symphony Amplifiers from D.C. mains **£12** post paid.

GARRARD 3-pin plug-in MAGNETIC PICK-UP HEADS for Fibre or Steel Needles, fit Garrard and Decca Arms. Prices: Standard **25/-**; Miniature high-impedance **35/-**; Miniature low impedance **25/-**. Postage 1/-. Garrard Arm **35/-**; Decca XMS Arm, **23/6**. Post 1/- Advice re. matching if required.

COLLARO latest model A.C.3/534 3-SPEED GRAM UNIT with new "STUDIO" Pick-up type "O" or "P," **£10/6/1**, post 2/6.

COLLARO latest model 3RC531 AUTOCHANGER with "STUDIO" PICK-UP type "O" or "P" **£15/3/10**, carr. 5/-. DITTO but Mixer (3RC532), **£17/9/6**.

COLLARO "STUDIO" PICK-UP (Arm and Head) type "O" or "P" **74/6**, post 2/-



No. 2

No. 2 "SYMPHONY" AMPLIFIER as No. 1 but with 10-watt Push-Pull triode output and triodes throughout. Woden mains and output transformers and choke. Full provision and power for Tuner. Output tapped 3, 7.5 and 15 ohms. Competes with the most expensive amplifiers on the market yet costs only **15 gns.** (carriage 5/-). Fitted in portable Steel Cabinet **2 gns.** extra.

"SYMPHONY" AMPLIFIERS with REMOTE CONTROL. Both the above model Amplifiers are available with all controls on a separate Control panel with up to 4 feet flexible cable which simply plugs into the amplifier. Enables the Amplifier proper to be set in the bottom of a cabinet whilst the controls are mounted conveniently higher up. Extra cost **2 gns.**

"SYMPHONY" BASS REFLEX CABINET KITS. 30in. high, consist of fully-cut ¾in. thick, heavy, inert, non-resonant patent acoustic board, deflector plate, felt, all screws, etc., and full instructions. 8in. speaker model, **85/-**; 10in. speaker model, **97/6**; 12in. speaker model, **£5/7/6**. The design is the final result of extensive research in our own laboratory and is your safeguard of optimum acoustic results. Carriage 7/6. Ready built, 10/6 extra.

RECORD PLAYER CASES, rexine-covered with hinged lid and carrying handle and fasteners and uncut motorboard. Standard model to spring-mount any Garrard, Collaro or B.S.R./Decca Gram Unit, **57/6**, post 2/6. Ditto autochanger size **90/-**, carriage 5/-. As Standard but extra large for Connoisseur Motor and one or two Pickups **67/6**, carr. 5/-.

CONSOLE AMPLIFIER CABINETS (right), 33in. high, lift-up lid, take Gram Unit or Auto-changer, Amplifier, Pre-amplifier, and Radio Feeder Unit, finished medium walnut veneer. De luxe version, **10 gns.**, carriage according to area. Bass Reflex Cabinets to match available. Details 2½d.

TAPE DECKS. We stock and recommend the latest TRUVOX Mark 3. Price **22 gns.**, carriage free. COMPLETE RECORDERS to TRUVOX specification as per Radio Show available. 2½d. details.

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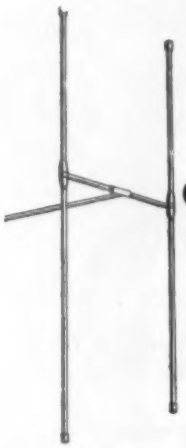
Buses: 2, 13, 31, 113, 187.

GOODMANS CORNER CABINETS (above) for the AXIOM 150 Mark 2, manufactured by us to Messrs. Goodmans own design. Price: complete kit in plain board with felt, **8 gns.** Price ready built, **10 gns.** Finished in figured walnut, **16 gns.** Other veneers to order. Carriage extra.

THE N.R.S. No. 2 PUBLIC ADDRESS AMPLIFIER for 200/250 volts A.C. mains gives output of 15 watts audio. Valve line-up; 6SL7, 6SN7, input and phase splitters, feeding 2 x 6V6 beam power tetrodes in push-pull, 5Z4 rectifier. Twin inputs with separate volume controls enabling gram. and mike or twin turntables to be faded in and out. Tone control is fitted and output is for 3, 7.5 and 15 ohms. This amplifier is built on the same de luxe hammer-finish chassis as the Symphony No. 2 and incorporates the same robust Woden mains transformer and choke, ensuring extreme reliability and absolute confidence in the instrument on the job. We can highly recommend this instrument as gramophone, microphone, and radio amplifier for dances, socials, etc., in halls, clubs, institutes, etc. Price in Kit form **£12**. Fully built and tested **13 gns.** Carriage 5/-. Hammer-finish Steel Cabinet with handles, **2 gns.** extra.



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"Our technical people tell us that an amazing number of people from all walks of life, visit them to chat about their home-built television sets. And, of course, there are many who take the trouble to write. We are delighted with their enthusiasm for we're enthusiasts ourselves and very willing to help with advice and "know-how". Most of them —though not all—are already users of our T.901 tubes, around which so many circuits have been designed. We are naturally pleased that home-constructors look to their T.901 for that quality which matches the results of their own patient labours."

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"All 'ENGLISH ELECTRIC' tubes are British made by the English Electric Valve Company, Chelmsford, Essex. During manufacture, at every stage, they are carefully tested to make certain that they conform to the stringent specification we lay down. As a result we know they will produce pictures of quality and high definition.

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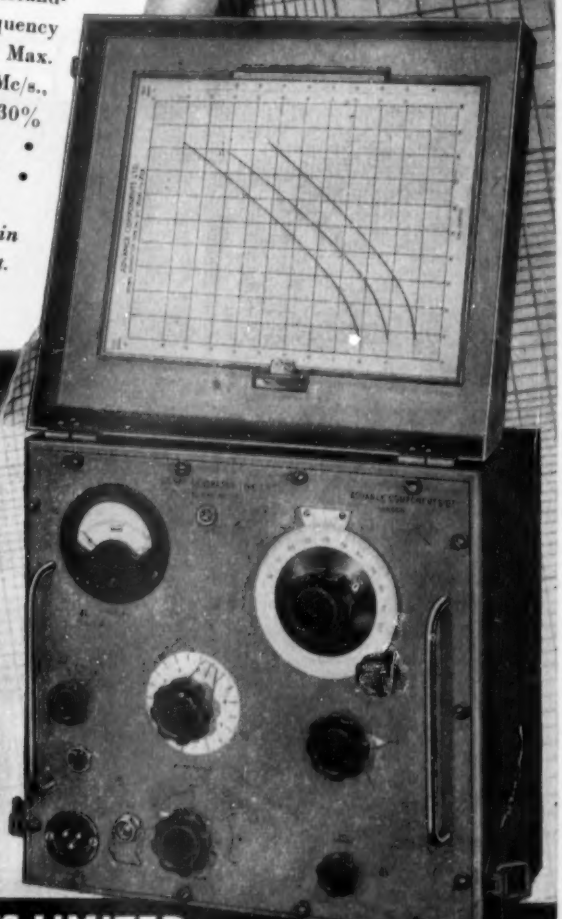

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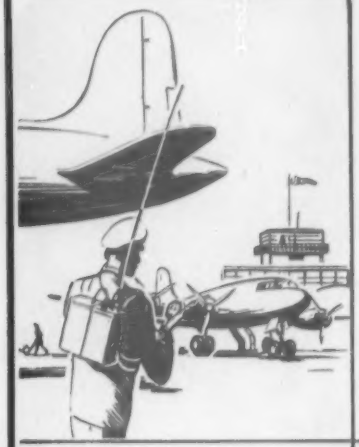

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★ lightweight
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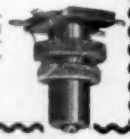
TYPE QT8.

A centre tapped wave-wound coil as illustrated for TRUVOX and similar tape-decks, single screw fixing. Fitted tags.



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P. Pat. 11925/53

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2	⅜in. x 1¼in.	
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Tommy-bars available.

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For cutting smaller holes neatly and quickly with one blow of a light hammer.

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Type	Hole Size	
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2	¼in.	
3	⅜in.	

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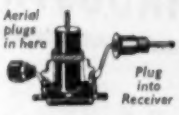

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The Separator may easily be tuned to eliminate any one Station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.
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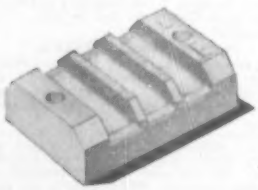

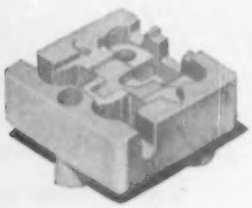

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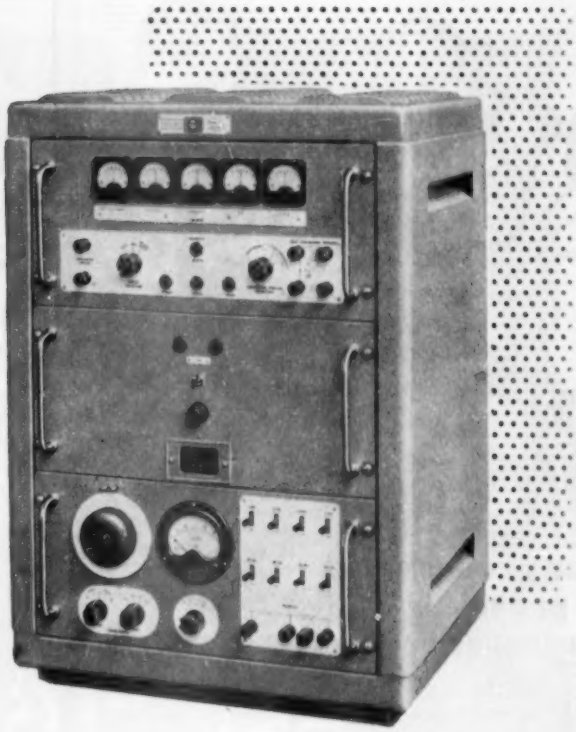

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The equipment will measure any frequency in the range 10c/s to 100kc/s and any time in the range 10μsec to 10^4sec both to an accuracy within ±0.005%. It will also count up to a maximum rate of 10^5 pulses/second.

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LUXOR RT

Luxor RT is the only record changer in the world having all the following advantages:

★ Automatic needle switch, guarantees correct needle for any record and eliminates the risk of damaging LP-needle and LP-records.

★ Patented feather-weight pick-up with "groove-feeler," automatically finds the first groove of a record regardless of record size.

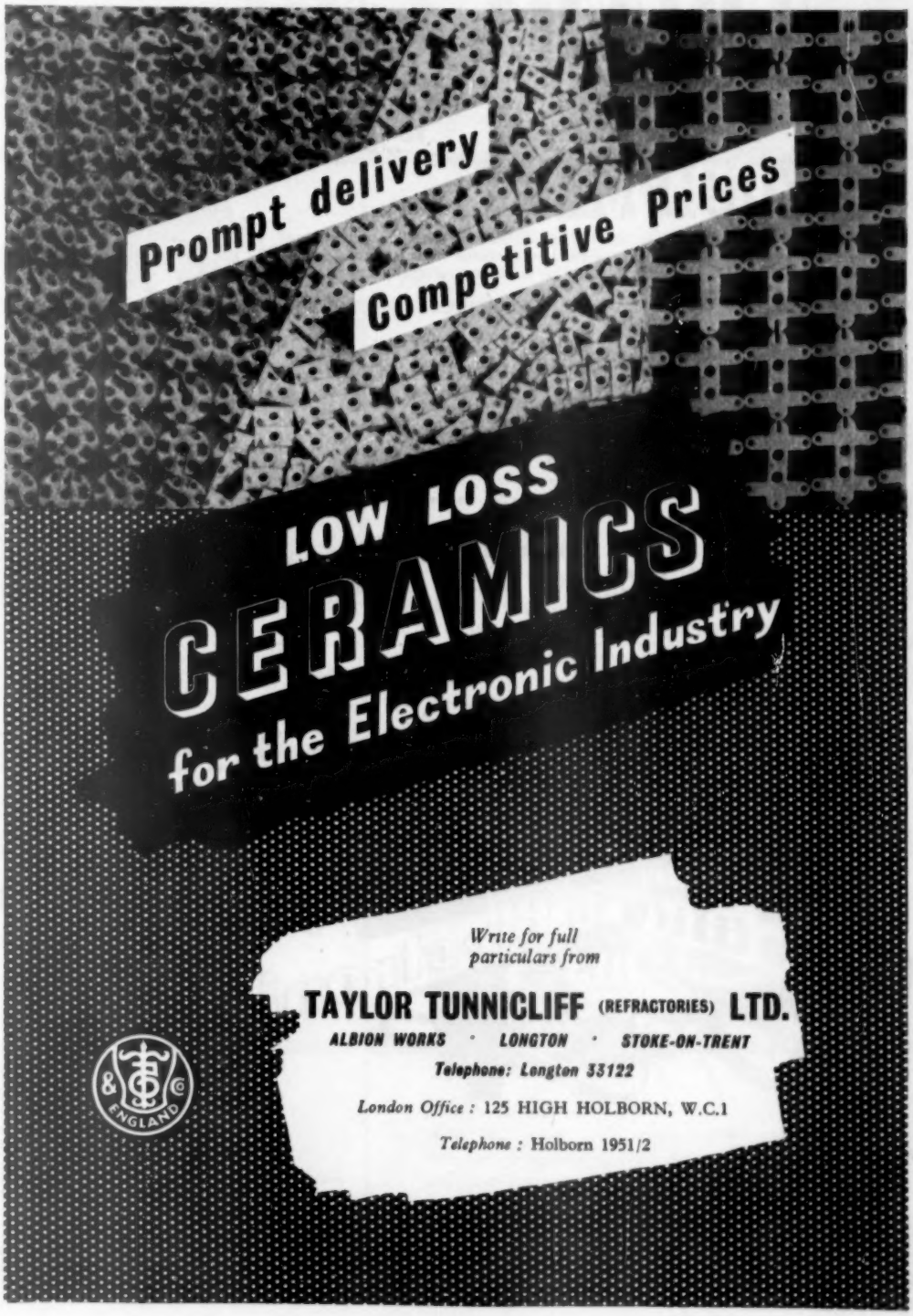
★ Direct drive at all speeds, assures the smooth running necessary for correct reproduction of the finest LP-records.

★ Automatic locking of the tone-arm when on the tone-arm rest, safeguards the pick-up from falling off and getting damaged.

You must know one thing only: Record speed. You have to make one operation only: Start and Luxor RT does the rest

LUXOR RADIO AB

MOTALA · SWEDEN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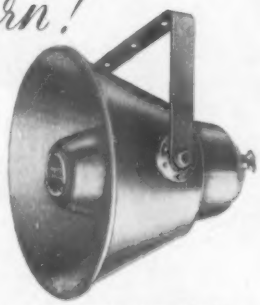
Profitable P.A. business is built upon a reputation for reliability which can only be based on the dependability of your equipment. That is why it pays to use only TRUVOX, the reproducers that have had reliability built into them for a quarter of a century.

TRUVOX PRESSURE TYPE DRIVING UNITS

Senior and Junior models have a power handling capacity of 15 and 10 watts respectively and provide a substantially linear response from 175 to 10,000 c.p.s. The Senior model is available with built-in tropicalised multi-radio transformer a noteworthy feature much appreciated by sound engineers.



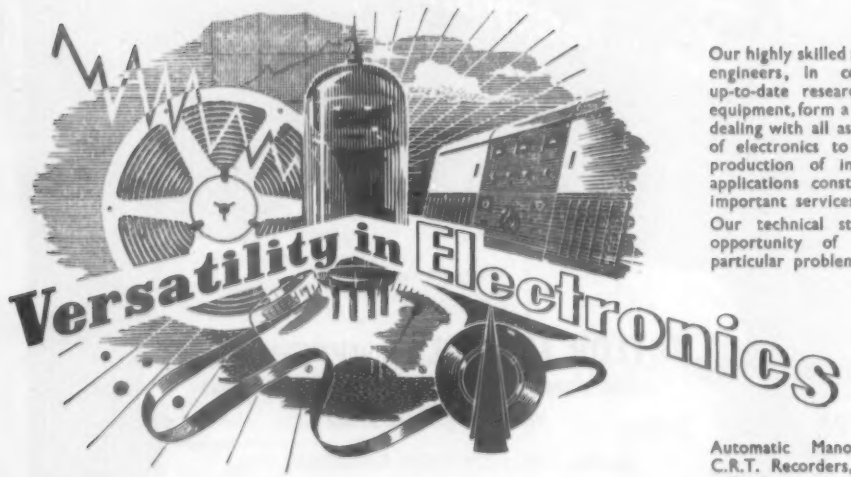
TRUVOX REFLEX SPEAKERS

Senior models give a substantially linear response from 250 to 8,000 c.p.s. with a peak handling capacity of 8 to 10 watts whilst Junior models range from 350 to 8,000 c.p.s. with 6 to 8 watts peak handling capacity. Either can be supplied with built-in transformer. Completely weather-proofed and designed to withstand prolonged exposure and vibration.

For Full Details Write to:

ROLA CELESTION LTD., FERRY WORKS, SUMMER ROAD, THAMES DITTON, SURREY

'Phone: Emberbrook 3402-6.



Our highly skilled and widely experienced engineers, in control of the most up-to-date research and manufacturing equipment, form a department capable of dealing with all aspects of the application of electronics to industry. Design and production of instruments for special applications constitute just one of the important services we offer.

Our technical staff will welcome an opportunity of tackling your own particular problems.

Automatic Manometers, Six-channel C.R.T. Recorders, High-speed Counters and Automatic Counting Equipment, Machine Tool Load Indicators and precision Control Gear, Displacement Transducers, Pressure Transducers, Load Ring Gauges, Portable Load Measurement Sets, High performance Stabilised Power Packs.

. . . . As supplied to Government Departments and many leading industrial concerns.

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7 Sound Reasons for choosing MSS Direct Recording Disks

NEGLIGIBLE BACKGROUND NOISE

M.S.S. disks permit of a dynamic range greater than 60 db. at 78 r.p.m. (max. stylus vel. 8 cm/sec., r.m.s.) and greater than 54 db. at 33 r.p.m.

WIDE FREQUENCY RESPONSE

The quality of the equipment used is the only likely limitation of the recording range of M.S.S. disks.

CLEAN SWARF THROW

The anti-static properties of M.S.S. disks ensure that with a correctly designed cutter the swarf is thrown towards the centre of the disk in a manner allowing of easy removal.

HIGH RESISTANCE TO WEAR

The groove walls of all M.S.S. disks will stand up to constant playback without diminishing the level of the higher frequencies.

SUITABILITY FOR PROCESSING

M.S.S. disks fulfil all processing needs; a special feature is the absence of the 'horn' or 'hangnail' at the groove edges even at high stylus velocities — a valuable advantage in microgroove recording.

RESISTANCE TO AGEING AND CLIMATE

M.S.S disks can be stored, blank or recorded, for indefinite periods under extremes of climate without loss of quality or performance.

FOUR GRADES SAVE YOU COST

A grading system based on selection enables you to choose the right priced disk for the job. For example, top grade disks must be beyond reproach in appearance as well as performance, and are, therefore, selected to conform to extra stringent standards of quality.

Contractors to
The Admiralty
General Post Office
Ministry of Supply
British Broadcasting Corporation

You can be certain of a perfect recording with M.S.S. disks. That is why so many leading recording and broadcasting companies throughout the world always use them. Let us send you further information on the four grades of M.S.S. disks available.

THE MASTER SOUND SYSTEM

M.S.S. RECORDING COMPANY LIMITED

POYLE CLOSE, COLNBROOK, BUCKS, ENGLAND. Phone: COLNBROOK 284

Manufacturers of Sound Recording Equipment

THE NEW

for cheaper radio listening

This new Ever Ready Battery, combining a 90 volt high tension unit and a 1.5v low tension section, has been designed for use with the latest Ever Ready low consumption valves, type DK96, DF96, DAF96 and DL96, which use only half the filament current (25mA) of the older series valves (50mA).

A balanced service life of 300 hours is obtained when the high tension current is 10.5 mA at 90 volts and the low tension current 125 mA at 1.4 volts; the respective cut-off voltages being 40v and 1.0v on load.

The maximum battery dimensions are $7\frac{11}{16}" \times 3\frac{7}{8}" \times 4"$ and the weight is 5 lbs. 10 oz. **Price 16/-.**

BATTERY PLUG

The new Ever Ready plastic 4 pin battery plug has been specially designed to ensure correct and easy battery connections. Plugs are fitted with four staggered metal pins, also four coloured wires 18" in length. List Price 2/- complete. Suitable for use with BSS. 1766-1951.

EVER READY DRY BATTERIES FOR RADIOS TORCHES · HEARING AIDS · CYCLE LAMPS

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by

ADCOLA
(Regd. Trade Mark)

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SOUND
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Standard model $\frac{1}{4}"$ bit (illustrated)

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Types are available for

Factory Bench Line,
Maintenance Engineer
& Home Constructor

Supplied for any volt range to meet our world-wide consumers' demands

- Heating time : 90 seconds.
- Consumption : 25 watts.
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- Handle unaffected by element temperature.
- Length of instrument : 9".
- Equally suitable for daily or intermittent use.

$\frac{1}{16}"$ dia. bit Standard Model.
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$\frac{1}{16}"$ Detachable bit Type (Factory Bench Line).

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Mullard

The practical application of transistors

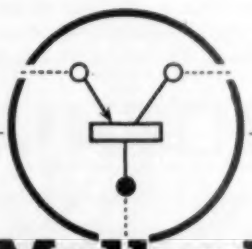
THE realisation of practical electronic equipments using transistors is dependent upon the success of three major development activities.

The first, which is basic work leading to transistor know-how, takes place in the research laboratories of the transistor manufacturer. In this field great progress has been made by Mullard, particularly in the control of material processing and purification. This is a pre-requisite in the large-scale production of transistors of consistent performance.

The second development activity takes place in the transistor manufacturer's own measurement and application laboratory. Here, Mullard have energetically applied the experience, so far gained, to the initial transistor research work and produced samples of five types of transistor. These samples, the forerunners of a comprehensive range, will be available almost immediately.

It is now possible, therefore, to proceed with the third essential activity. This is in the development laboratories of the equipment manufacturer, who can contribute to the continuing progress by experimentally applying these sample transistors to typical examples of his problems.

Designers of equipment who wish to experiment with these new transistors are invited to apply now for samples and data. The experience of the Mullard Industrial Technical Service Department is available for those wishing to draw on it in the solution of transistor problems.



Mullard

MULLARD LIMITED, COMMUNICATIONS & INDUSTRIAL VALVE DEPT.
CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

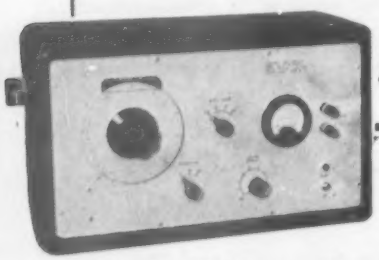
MVT 147

FOR WIDE RANGE FREQUENCY AND VOLTAGE

AUDIO FREQUENCY SIGNAL GENERATOR

Model LO63

Accuracy to ± 1½% or 0.5 cycle



- *Completely Self-contained*
- *Operates from A.C. Mains—Stabilised Voltages*

FREQUENCY RANGE: 50 cycles to 55,000 cycles.
BASIC RANGE: 50-550 cycles direct reading on a 6" diameter scale over an arc of 300.
MULTIPLIER: 1, x 10, x 100.
TOTAL SCALE LENGTH: 48".
Alternatively 30-33,000 cycles or 10-11,000 cycles.

Here is a standard calibrated audio frequency voltage generator designed to cover a wide range. The use of high value capacity components in the bridge circuit allied to the two valve phase-shift oscillator which is equipped with fully automatic electronic feed-back control, results in a circuit of exceptionally high stability.

Please write for full specification.

BRITISH PHYSICAL LABORATORIES

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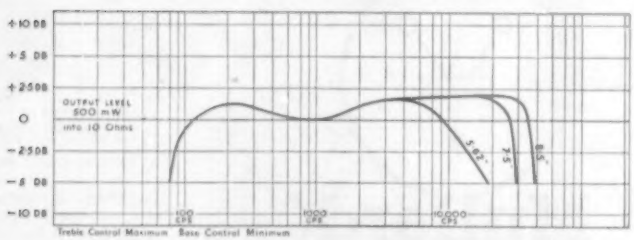
dmBP14

Reflectograph

MAGNETIC TAPE RECORDERS

Reflectograph development now provides a high performance Scientific and Industrial Recorder with a frequency response as graph. The continuously variable speed capstan unit permits a range of tape speeds from 8½in. to 1⅞in. per second, with a " wow " and " flutter " content no greater than .2% at 7½in. and .3% at 1⅞in. per second. These instruments are fitted into transportable steel cabinets with carrying handles. Models with more than two tracks are built into console type steel cabinets mounted on castors, or in standard Post Office type racks.



For full information on the Reflectograph range write to the Manufacturers.

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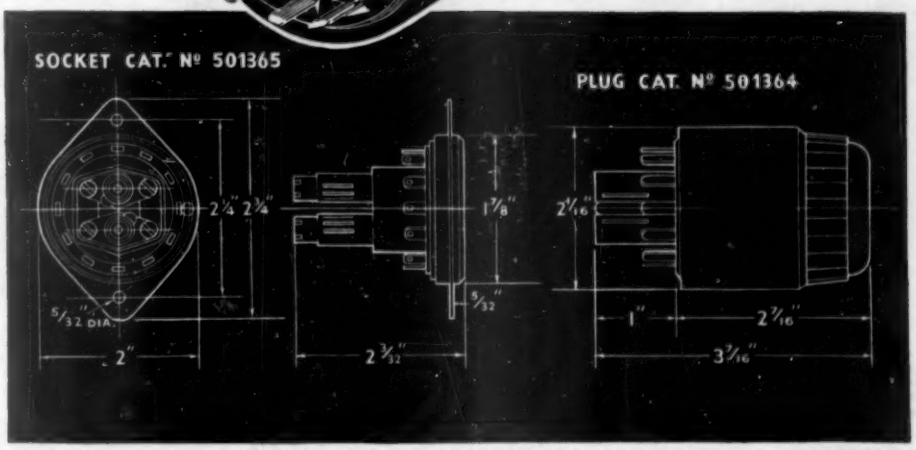
PAINTON

By Appointment to the Professional Engineer

PLUG AND SOCKET CO-AXIAL/MULTI CONTACT

These plugs and sockets have twelve ancillary contacts to carry Audio signals, or power supplies up to 500 Volts/5 Amps. The Coaxial units can connect signals at either Video or Radio frequencies. The combination of these facilities into a single unit has numerous and obvious applications. By eliminating the need for a number of separate and different connectors, wiring problems are eased; and the simplified chassis or panel design has an improved appearance. The "Hammer finished" covers are supplied to match Customers' individual colour schemes.



PLUG WITH COVER . . . . . Type 501364
PLUG WITH MOUNTING FLANGE . . Type 501544
SOCKET WITH COVER . . . . . Type 501545
SOCKET WITH MOUNTING FLANGE . . Type 501365

(A composite cable for the above range has been developed by British Insulated Callenders Cables Limited)

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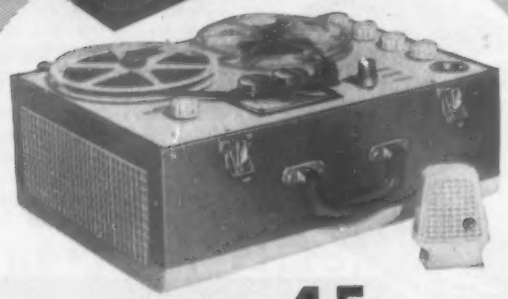
C

Everybody IS TALKING ABOUT

THE Editor

SUITCASE TAPE RECORDER



- ★ REALLY PORTABLE LIGHTWEIGHT & COMPACT
- ★ OUTSTANDING PERFORMANCE
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- ★ BASS AND TREBLE CONTROLS
- ★ FULLY AUTOMATIC
- ★ TWIN TRACK HEADS
- ★ FAST REWIND
- ★ HIGH FIDELITY PLAYBACK
- ★ FULLY GUARANTEED

ONLY 45gns.

(Carr. and pkg. 15/-)

H.P TERMS

£15/15/- Deposit, 12 monthly instalments of 60/-
Or 18 monthly instalments of 42/-.

CREDIT TERMS

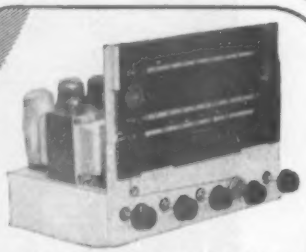
Send only £6 to secure with 8 further monthly payments of £6.

We stock and recommend the EDITOR SUITCASE TAPE RECORDER, made by TAPE RECORDERS (ELECTRONICS) LTD. This exceptionally high quality low priced unit embodying remarkable developments in chassis construction, is the smallest and lightest all-mains fully automatic tape recorder made. The operating height of only just over 5 inches is made possible by the ingeniously planned, compact chassis, which is easily and quickly removed from the case in a matter of seconds for inspection.

★ Tape speed 7½in. per second. ★ Mullard miniature valves. ★ Twin track heads. ★ Three high grade specially designed recording motors provide fast forward run and 50 sec. rewind without unlacing tape. ★ Independent Bass and Treble Controls for recording and playback. ★ Negligible wow and flutter. ★ Overall negative feedback. ★ 1,200ft. reel of tape will provide over ONE hour playing time. ★ Amplifier may be used independently for high quality record reproduction and public address. ★ High fidelity Record head. ★ Special high grade speaker. ★ Provision for external speaker. ★ Speaker muting switch. ★ Extremely high output and brilliant reproduction. ★ Positive servo braking on all functions. ★ Compact size for ease of handling, only 16½in. × 12in. × 7in. (with lid). ★ Magic eye recording indicator. ★ Weight only approx. 23lbs. ★ 200-250 v. A.C. Mains.

ACCESSORIES

The "Editor" is supplied complete and ready for use with crystal desk microphone made specially for this equipment by SONETTE.
A 1,200ft. reel of high capacity BURGOYNE tape is also issued with every recorder. This tape is especially recommended and is available at 35/- per 1,200ft. reel or 21/- per 600ft. reel.



THE RG1 8 VALVE SUPERHET

RADIOGRAM CHASSIS

- ★ Illuminated full vision coloured tuning scale 11¼in. × 6¼in.
- ★ Negative feedback.
- ★ Bass and treble controls for cut and lift.
- ★ For 200-250 v. A.C.
- ★ Wavebands 16-50; 190-550; 1,000-2,000 metres.
- ★ Magic eye tuning indicator and precision fly-wheel tuning.
- ★ 8 watts push-pull output.
- ★ Designed to obtain the best results from modern gramophone technique.
- ★ Full guarantee for TWO YEARS.

Price 22 gns.

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H.P. TERMS :— £7/14/- Deposit with 12 monthly payments of 29/-. (Carr. & Pkg. 7/6).
CREDIT TERMS :— Yours for 59/- and 8 further equal monthly payments.
FOR EXPORT :— Our Price is £17/10/-. excluding P.T.

M·O·S *See them at the Radio Centre*

E & O. **MAIL ORDER**

Telephone: MUSeum 6667. THE RADIO CENTRE.

The M.O.S.
PERSONAL CREDIT PLAN

Any equipment in our vast range of merchandise may be purchased under this plan, which is essentially a personal one, as everybody has different requirements.

Two methods of purchase are available: CREDIT SALE OR HIRE PURCHASE. The first allows you to own your equipment on payment of a first instalment of nine which are spread over 9 months. We show the first instalment as one-ninth of the total purchase price, but if you so desire the first instalment can be any sum you please (within reasonable limits).
The second method secures delivery on payment of one-third of the cash price and the balance plus charges spread over any period up to 18 months. Again, we show payments spread over 12 months, but this may be varied. Your enquiries and order will be dealt with confidentially whether by mail or personal shopping. We have years of experience behind us to advise and help you on your choice of goods. Carriage and packing is extra, all prices quoted being ex warehouse and subject to market fluctuations. We detail below a further selection of recommended items. If you do not see your need here, you may rest assured we can get it for you if it is available. Comprehensive lists are available upon request.

ITEM	CASH PRICE	CREDIT SALE 9 instalments of	OR H.P Deposit	12 Mthly payments of
AMPLIFIERS				
Acoustical Quad II	£42 0 0	106/6	£14 0 0	53/6
Burgoyne A7 pre-amp.	£3 10 0	11/-	£1 3 4	7/-
EMG Steep Cut Filter	£4 10 0	14/2	£1 10 0	8/-
Goodsell GW18 Williamson	£33 5 0	85/-	£11 1 8	42/6
" GW18/C "	£36 0 0	91/6	£12 0 0	46/-
" GW12 "	£27 10 0	71/-	£9 3 4	36/-
" GW12/C "	£29 0 0	74/4	£9 13 4	37/6
" MA5 Amp.	£13 10 0	34/6	£4 10 0	18/6
M.O.S. A8 3 valve Amp.	£5 12 6	14/-	£1 17 6	8/3
Rogers Williamson Senior	£28 0 0	72/-	£9 9 0	36/2
Rogers Williamson Pre-Amp.	£12 0 0	31/6	£4 0 0	16/8
Rogers Baby de Luxe	£14 0 0	35/6	£4 13 4	19/-
Rogers Junior Pre-Amp.	£9 0 0	24/6	£3 0 0	13/4
Truchord 50T	£26 5 0	67/1	£8 15 0	33/6
CONVERTERS D.C./A.C.				
Valradio 110A	£11 16 6	30/8	£3 18 10	16/4
" 200A	£15 8 0	39/2	£5 2 8	20/7
CATHODE RAY TUBES				
9in. Mullard, Mazda, G.E.C., etc., etc.	£12 10 0	32/2	£4 3 6	17/2
10in. Ditto	£14 18 11	38/-	£4 19 8	20/-
12in. Ditto	£16 13 8	42/2	£5 11 3	22/-
16in. Ditto	£22 4 10	57/-	£7 8 3	28/6
GRAMOPHONE UNITS				
Garrard TB with 2 Decca XMS Heads	£12 15 0	32/8	£4 5 0	17/7
Collaro AC3/534	£10 6 1	27/4	£3 8 9	14/9
" 3RC531	£15 3 10	38/8	£5 1 4	20/4
Connoisseur 3-speed Transcription with Pick-up and 2 Heads	£30 12 9	78/3	£10 4 3	39/3
LOUDSPEAKERS				
Wharfedale W15CS sand-filled enclosure	£47 0 0	184/-	£24 0 0	92/-
Treble Assembly	£16 10 0			
HS/CR3 Crossover	£8 10 0			
	£72 0 0			
MICROPHONES				
Burgoyne Crystal Desk	£2 15 0	9/4	—	—
Cosmocord 16-2	£12 12 0	32/6	£4 12 0	16/8
Reslo Ribbon R	£9 0 0	24/6	£3 0 0	13/4
Rothermel 2AD56	£2 9 6	9/-	—	—
Ronette HM Filtercel	£4 7 6	14/3	£1 7 6	8/-

ITEM	CASH PRICE	CREDIT SALE 9 instalments of	OR H.P. Deposit	12 Mthly payments of
RECEIVERS, ETC.				
Burgoyne RG1 8-valve Superhet Chassis	£23 2 0	59/-	£7 14 0	29/-
Burgoyne RF1 Feeder	£3 12 6	11/4	£1 4 2	6/4
Chapman S4 Tuner	£16 0 0	41/-	£5 6 8	21/2
" S5/S5E Tuner	£21 6 8	54/2	£7 2 2	27/-
Ferguson 400 RG Radiogram	£89 5 0	228/-	£29 15 0	112/10
Ferguson 500 RG Radiogram	£241 10 0	621/-	£80 10 0	305/3
Leak Tuner	£35 0 0	89/-	£11 13 4	46/6
Portrola Decca	£35 15 6	90/7	£11 18 6	47/3
Quad Radio Unit	£24 10 0	62/3	£8 3 4	31/3
Truchord "Octavia"	£94 10 0	241/-	£31 10 0	21/-
" HF Radio Unit	£16 16 0	42/10	£5 12 0	22/-
" 101A	£19 8 5	49/2	£6 9 8	25/-
" Radio Unit for Grundig	£20 16 1	53/2	£6 18 8	27/-
RECORD PLAYERS (WITH AMPLIFIER)				
E.A.R. Music Maker, non-auto	£19 15 0	49/3	£6 11 8	25/4
E.A.R. Music Maker, auto	£24 17 6	62/-	£8 5 10	31/6
Regentone P33	£30 9 0	76/9	£10 3 0	40/4
" Handygram	£19 19 0	49/9	£6 13 0	25/7
Trixette A375	£37 16 0	95/2	£12 12 0	48/4
" Playdisc	£22 1 0	57/-	£7 7 0	28/6
TAPE RECORDING				
Lane Table	£17 10 0	42/10	£5 16 8	22/-
Truvox Deck	£23 2 0	59/-	£7 14 0	29/-
Wearite Deck 2A	£35 0 0	89/-	£11 13 4	46/6
" " 2B	£40 0 0	102/-	£13 6 8	51/1
Motek Table	£16 10 0	42/-	£5 10 0	21/8
B.S.R. Motors FP10	£1 18 0	7/1	12 8	4/1
Burgoyne Heads	£1 17 6	7/-	12 6	4/-
Tamsa Heads	£2 7 6	8/2	15 10	4/4
Baird Soundmaster Recorder	£68 5 0	171/-	£22 15 0	86/6
CJR D2 Recorder	£117 0 0	300/-	£39 0 0	149/6
Editor Suitcase Recorder	£47 5 0	120/-	£15 15 0	60/-
Emicorda Recorder	£94 10 0	242/-	£31 10 0	120/9
Grundig Recorder	£84 0 0	213/-	£28 0 0	106/9
Vortexion Recorder WVA	£84 0 0	213/-	£28 0 0	106/9
Soundmaster Kit	£60 0 0	152/-	£20 0 0	79/-
Burgoyne Oscillator Unit	£1 17 6	7/-	12 6	4/-
Vortexion Electronic Mixer	£36 15 0	92/7	£12 5 0	46/9
TEST EQUIPMENT				
Amplion Test Meter	£5 0 0	15/-	£1 0 0	10/-
Cossor 1052 Oscilloscope	£104 0 0	266/-	£34 13 4	132/10
Denco Modulated Test Oscillator MTO 1	£3 15 0	12/9	£1 5 0	7/6
Pullin Series 100 Test Set	£11 11 0	30/-	£2 0 0	20/-
Taylor 150A Output Meter	£33 10 0	85/11	£11 3 4	42/8

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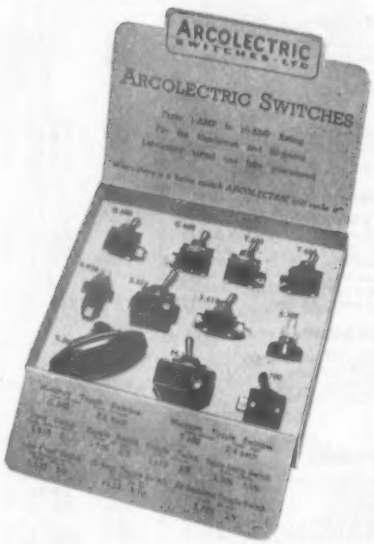
ARCOLECTRIC

DEALER'S DISPLAY BOX

This new display box contains eleven assorted switches—toggle switches and appliance switches. The switches are priced at 30/10d. subject, there is no extra charge for the box.

Arcolectric Display Boxes were first introduced five years ago. The latest box contains a carefully selected range of appliance switches. Experience has shown that these are just the sort of switches handymen and home constructors will demand. For your own repair jobs you will find these switches useful.

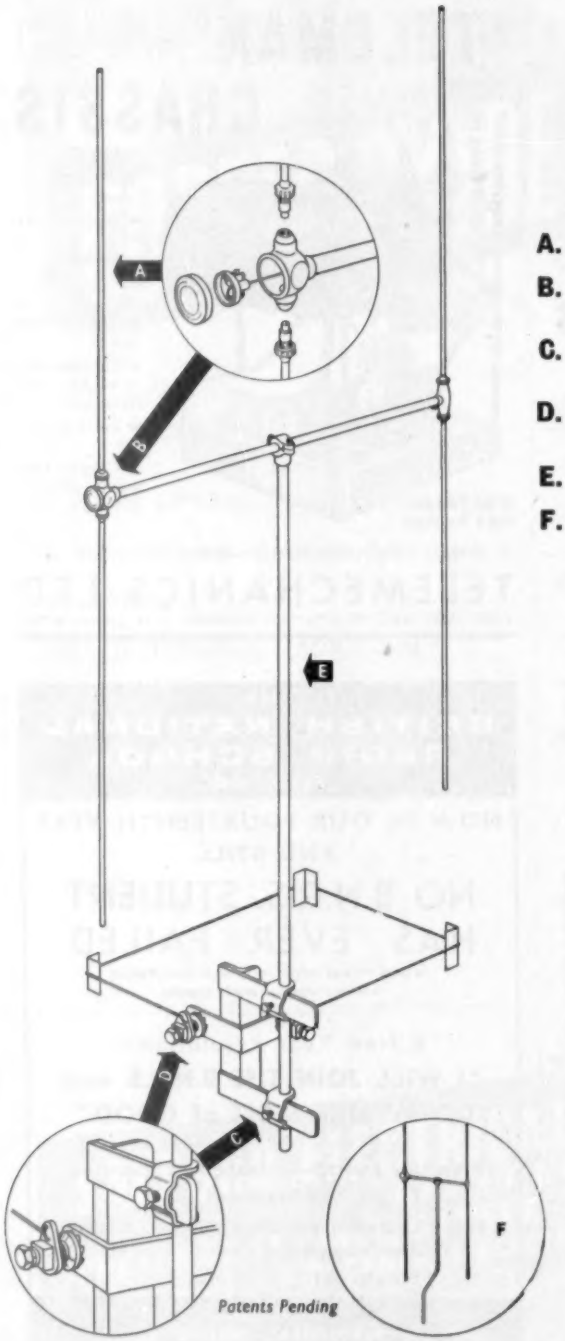
Available from all good wholesalers or direct from the factory.



Complete 30/10 subject

ARCOLECTRIC
SWITCHES · LTD

CENTRAL AVENUE, WEST MOLESEY, SURREY · TELEPHONE: MOLESEY 3336 (3 LINES)



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WITH PRESS ON WATER-PROOF COVER.

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D. RATCHET STRAINERS FOR EXTRA RAPID ERECTION

E. TYPE TS/50 WITH 7ft. MAST

F. POPULAR "H" 5ft. "STAND-OFF" ARM.

The TELECRAFT 1954 series of outdoor Aerials have been re-designed — but all the outstanding features that have made TELECRAFT Aerials famous are retained.

Extra RAPID ASSEMBLY is certain, the Elements can be inserted right on site, merely screw in. Contact is assured by pressing home previously wired clip assembly and finally a little pressure on water proofing plastic cover plate will ensure complete and lasting weather protection.

TELECRAFT Designers have spent a lot of time designing a new range of CHIMNEY BRACKETS and can now state that the new Chimney Brackets are far in advance of any contemporary types.

Basically of steel for optimum strength, we have introduced a DIECAST RATCHET ASSEMBLY employing 8 pawls, providing utmost physical strength and extremely fast cable straining.

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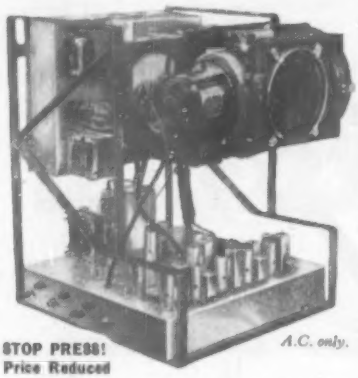

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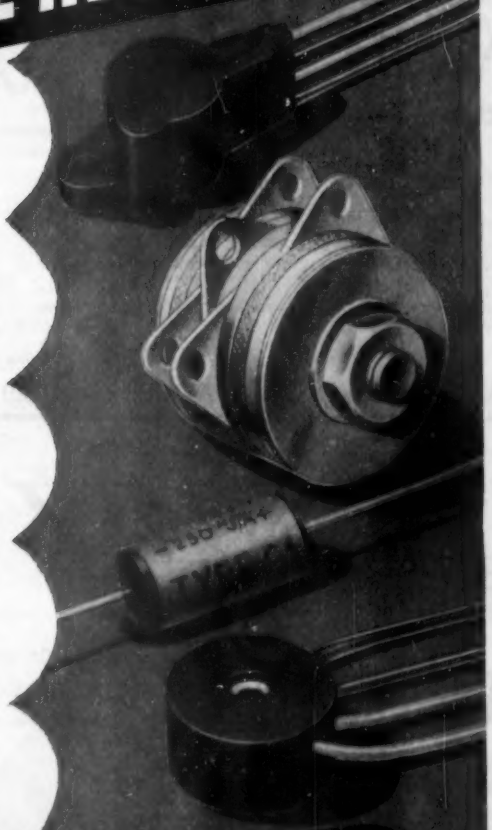

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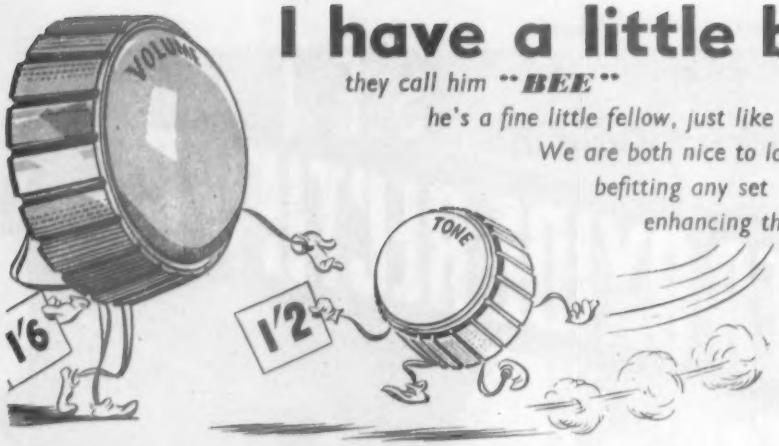

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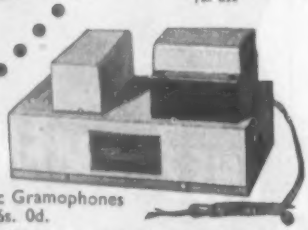

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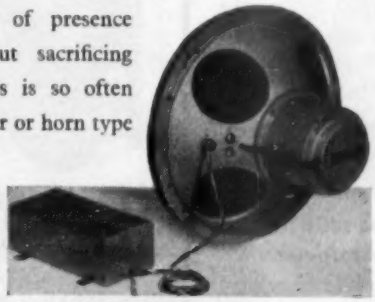

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Running at 2,700 r.p.m continuously or intermittently in either direction or continuously reversed.

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RQR

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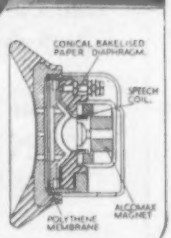

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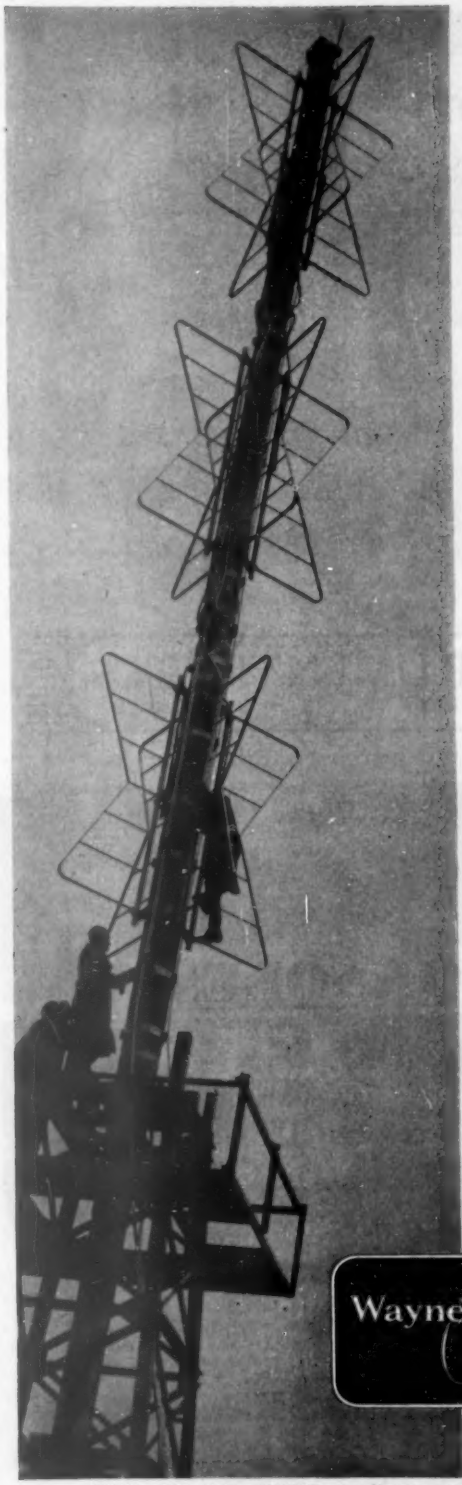
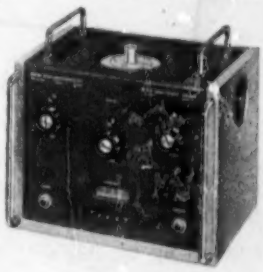


Broad-band Matching

The photograph shows Marconi engineers erecting for test the three-stack super-turnstile TV aerial for the new B.B.C. transmitter at Pontop Pike. Wayne Kerr Bridges are used for matching feeders and transmission lines to the radiators.



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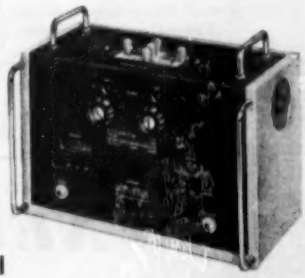
B.901

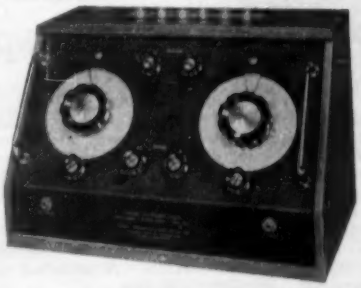
Susceptance: *Equivalent to ± 75 pF to ± 2%, ± 0.5 pF*
Conductance: *0-100 mmho to ± 2%, ± 0.1 mmho*



FOR BALANCED AND UNBALANCED MEASUREMENT FROM 1—100 MC/S

B.801 and B.701

Susceptance: *Equivalent to ± 230 pF to ± 2%, ± 0.5 pF*
Conductance: *0-100 mmho to ± 2%, ± 0.1 mmho*
Susceptance: *Equivalent to ± 80 pF to ± 2%, ± 0.5 pF*
Conductance: *0-100 mmho to ± 2%, ± 0.02 mmho*



FOR BALANCED AND UNBALANCED MEASUREMENT FROM 15 KC/S—5 MC/S

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Resistance: *10 ohms — 10 megohms*
Inductance: *0.5 μH — 50 mH*
Accuracy: *1% over major part of range*

These Wayne Kerr Bridges are used with external source and detector for the measurement of aerials, cables, feeders, and a variety of components and materials.

Wayne Kerr

Photograph by courtesy of Marconi's Wireless Telegraph Co. Ltd.

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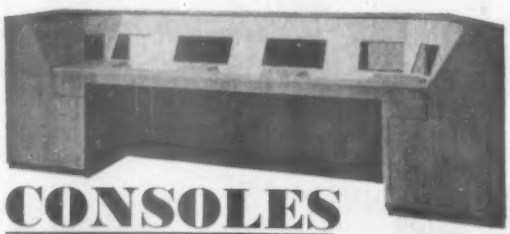

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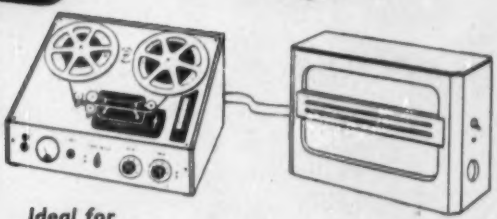

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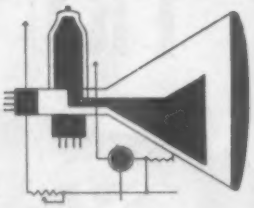

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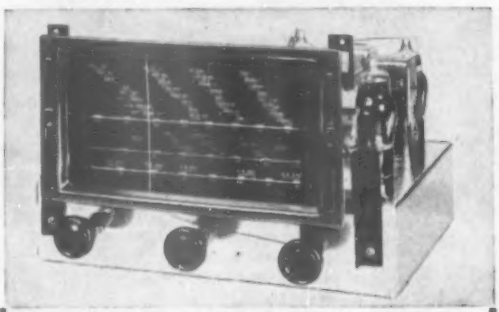

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CONSTRUCTIONAL DETAILS FOR BUILDING THIS FINE SUPERHET CONTAINED IN
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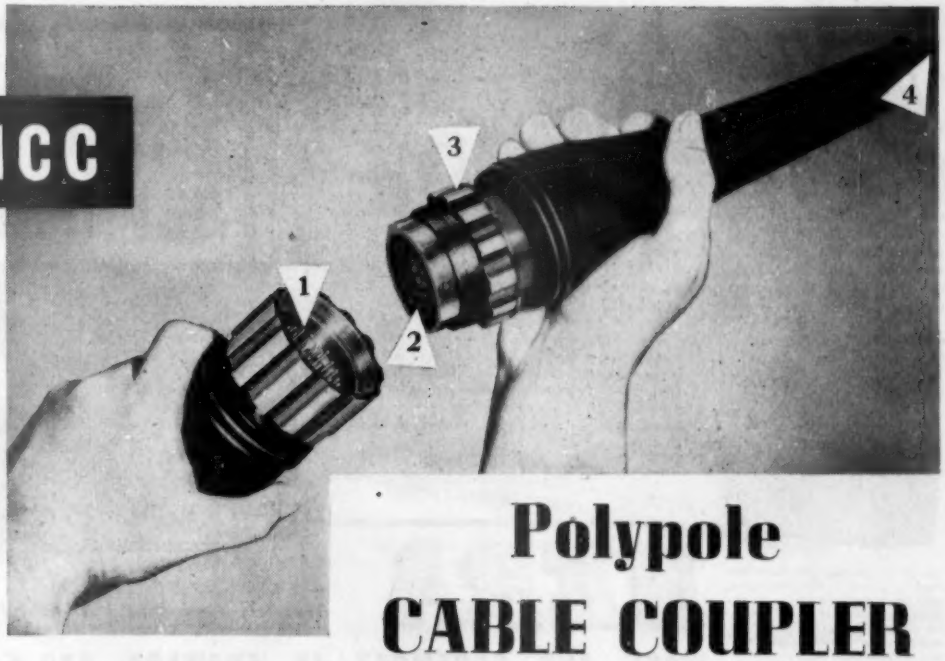

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For- *specialised remote control—centimetre radio links—ground radar—outside broadcast television*

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The couplers are permanently moulded to the ends of the cable in the factory. This technique provides a remarkably robust coupler which is virtually free from the hazards of conductor breakages near to, or within the coupler.

If you are interested in the uses of BICC Polypole Cable Couplers, we will be pleased to send you further information.

Note these important features

1. The couplers are assembled with the conductors in tension to ensure that they each contribute their share of the total strength.
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The above photograph shows the receiver closed, in this position it may be securely locked. On the right the receiver is shown opened for viewing. Note the remote control panel on the right hand side of cabinet.

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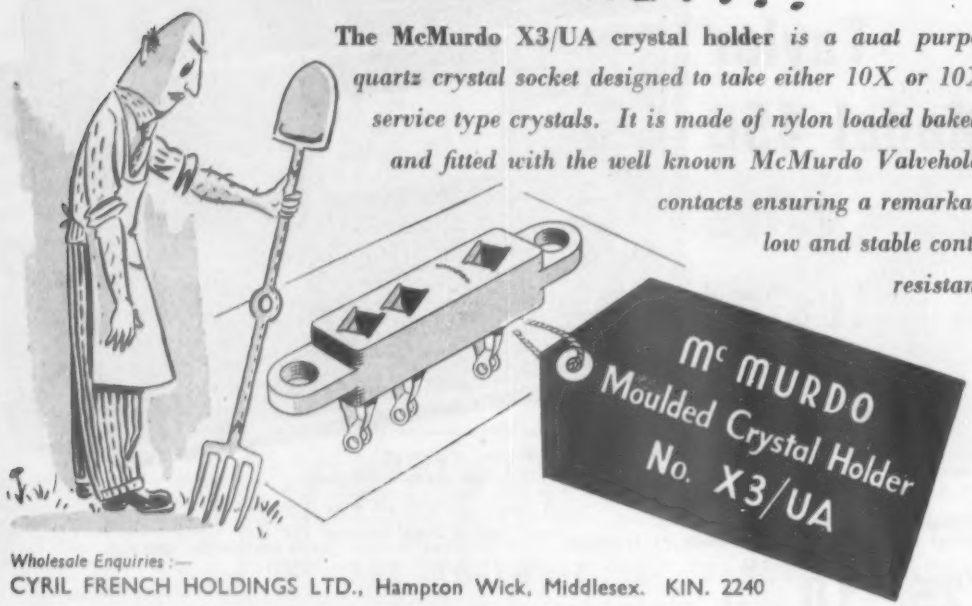

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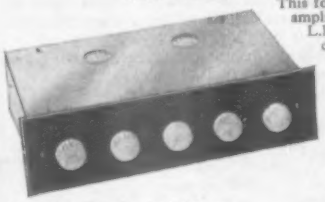

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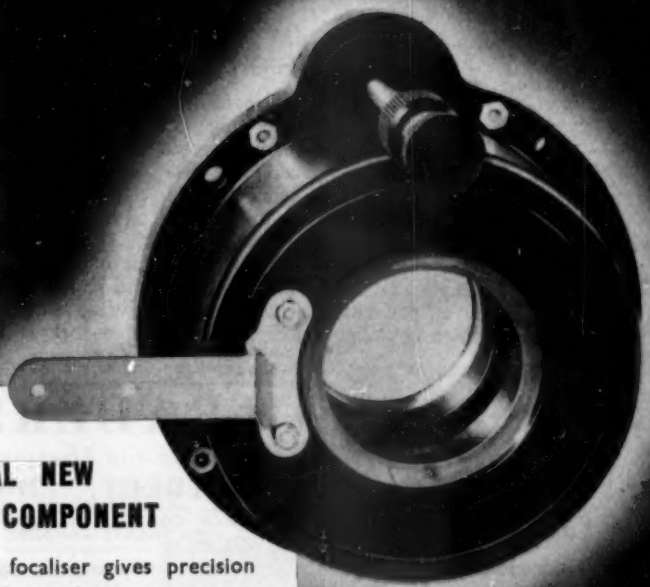

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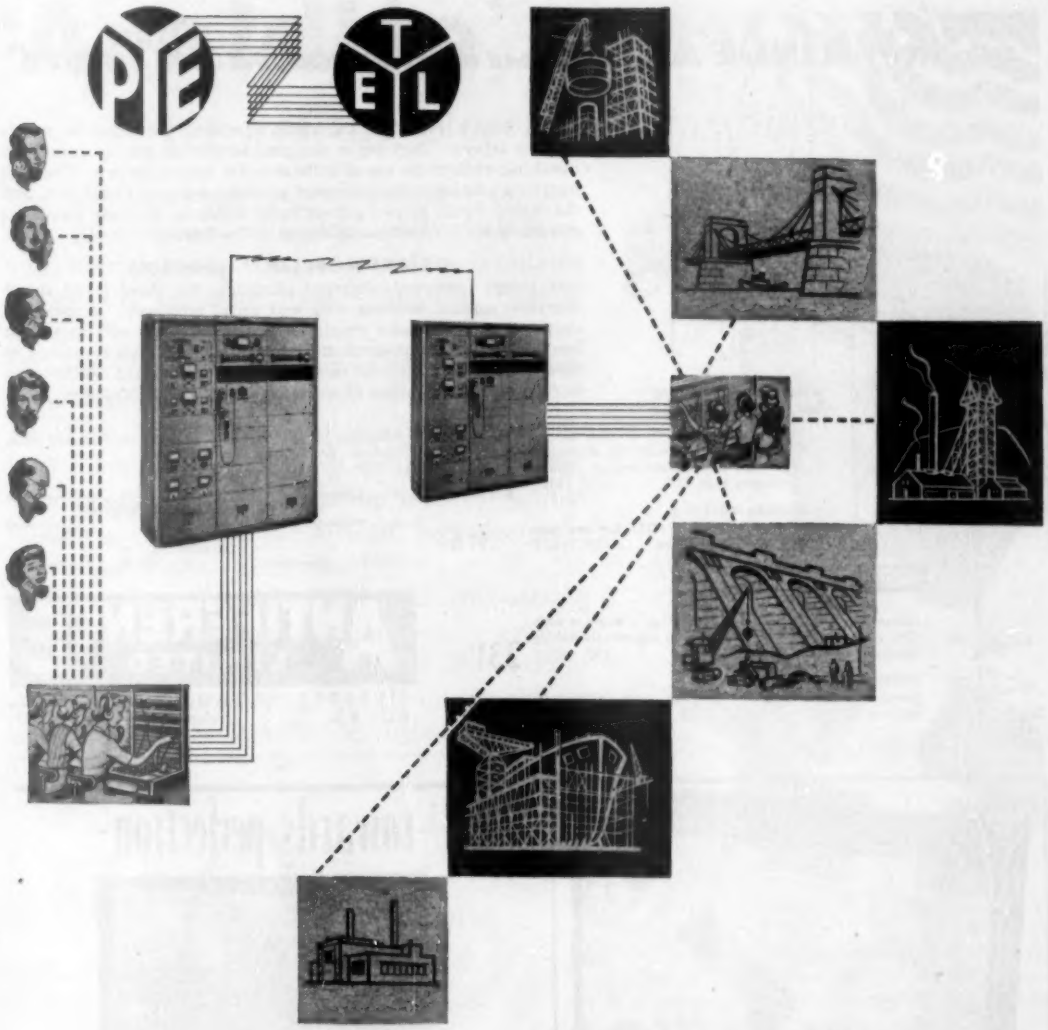

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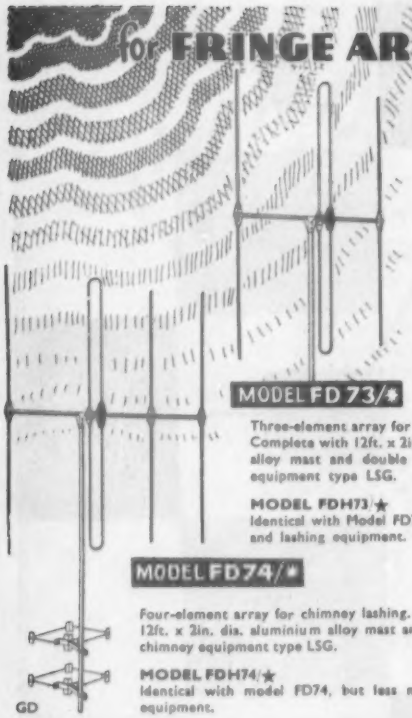

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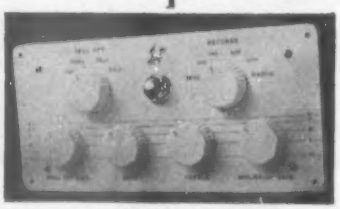

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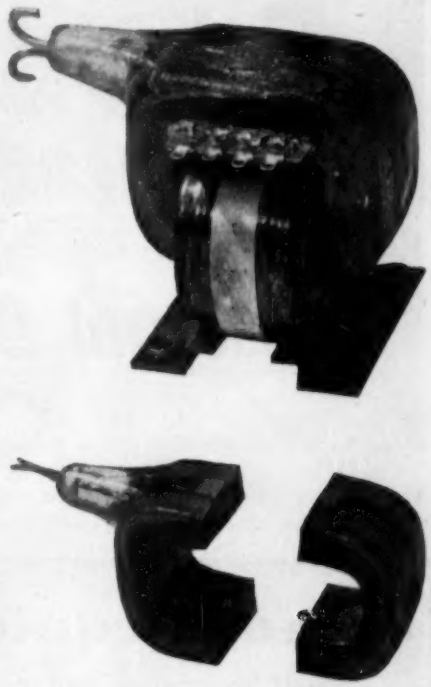

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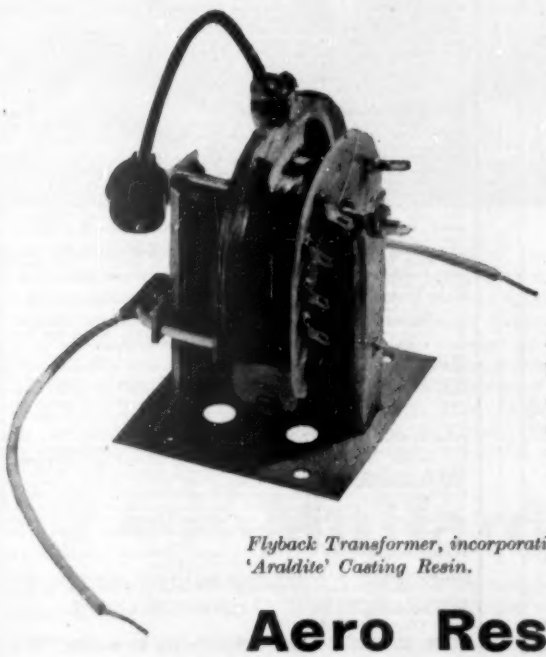

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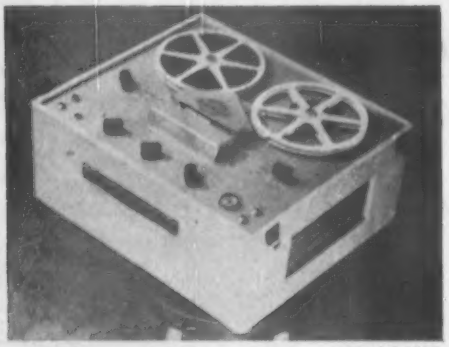

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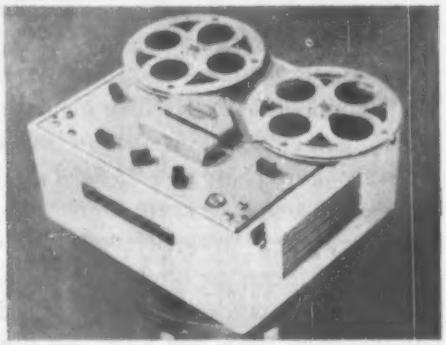

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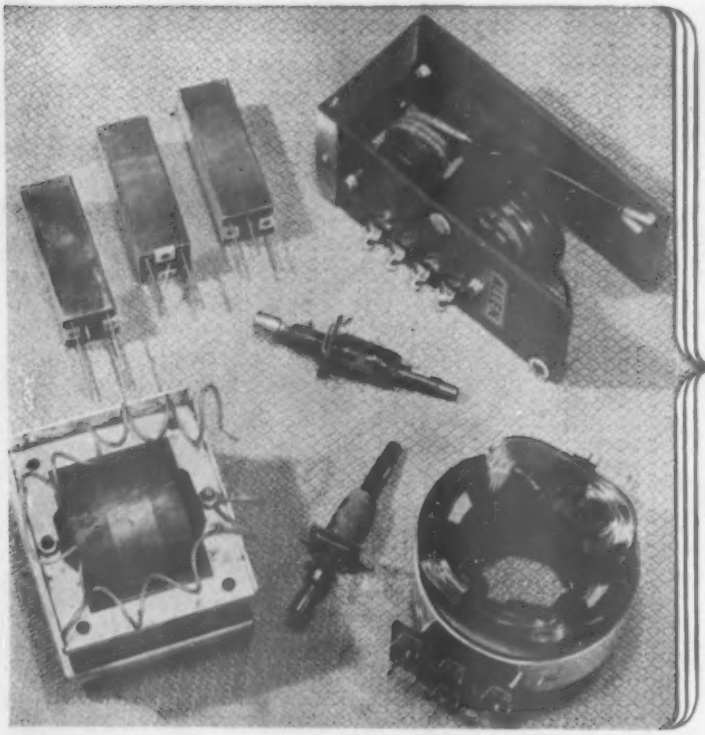

THESE STANDARD WIDE ANGLE COMPONENTS ARE USED IN THE "TELEKING" AND "SUPERVISOR"

Also for the conversion to 14" or 17" C/R tubes of all popular home-built televisors

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From all Leading Stockists

ALLEN
COMPONENTS LIMITED
Crown Works, Lower Richmond Rd.,
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Telephone: Prospect 9013

Send 9d. and S.A.E. for Circuit Diagram

OVER
90%
WATT/HOUR EFFICIENCY

and savings up to ⅓ of the size and ⅔ of the weight in comparison with other storage batteries of similar capacities. The Venner silver-zinc accumulator is ideal when exceptionally high rates of discharge are a necessary requirement.

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VENNER *Lightweight* **ACCUMULATORS**

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Telephone: MALden 2442

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AT TO-DAY'S KEENEST TRADE PRICES
we are comprehensive stockists of quality condensers, resistors, potentiometers, transformers, valves and engineers' sundries of all kinds.

STOCKISTS OF "HOME CONSTRUCTOR" KITS
"Sound Master" Tape deck and amplifier. "Truvox Mark III Tape Deck" and amplifier components. "View Master" and Tele-King Televisor Kits, etc.

FAST TRADE SERVICE GIVEN ON REPAIRS
to loudspeakers and transformers. Special Transformers to own specs.

A.W.F. CONE ASSEMBLIES
for L/S repairs in your own workshops at economical rates

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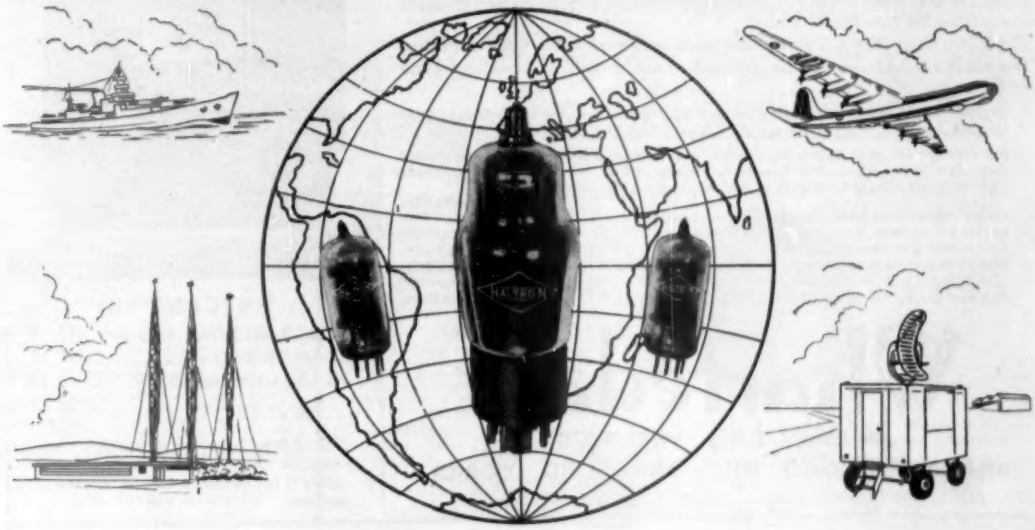
Phone 24008. Cables "Testube"

Once again, we take the opportunity of thanking our Clients throughout the world, for their support during 1953 and of wishing them a happy and prosperous year in 1954.



DURING 1953 **HALTRON** **RADIO TUBES**

BOTH RECEIVING AND TRANSMITTING TYPES WERE EXPORTED BY US TO THE FOLLOWING COUNTRIES:—

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OVER 900 TYPES IN STOCK

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OMNI-DIRECTIONAL **3-Speaker System**

W15/CS SUPER 8/CS SUPER 5

Treble Units Facing Upwards Crossover Frequencies 800 and 5,000 c/s

The bass speaker is the W15/CS with a fundamental resonance below 30 C/S; the middle speaker is the Super 8/CS; and the third speaker is the Super 5 with response well maintained to 16,000 C/S. The crossover unit is a ½ section type, with crossover frequencies of 800 and 5,000 C/S. A volume Control is now fitted to the middle and top speakers which also face upwards to avoid undue directional effects.

The Wharfedale W10/CS unit is also suitable for use as the middle speaker.

The horizontal cabinet can be supplied to suit a 10in. unit without extra charge.

DEMONSTRATION—*The following Radio Retailers are equipped to give demonstrations of the Wharfedale Three-Speaker System :—*

B-K Partners Ltd., 229, Regent St., London, W.1 (entrance Hanover St). *Tel: Regent 1051*
City Sale & Exchange Ltd., 93/4, Fleet Street, London, E.C.4. *Tel: Central 9391*
Classic Electrical Co. Ltd., 364, Lower Addiscombe Road, Croydon, Surrey. *Tel: Addiscombe 6061*
Holley's Radio Stores, 285, Camberwell Road, London, S.E.5 *Tel: Rodney 4988*
Jewkes & Co., 28/31, Broad Street, Birmingham, 1. *Tel: Midland 4829*
C. Milsom & Son, North Gate, Bath. *Tel: Bath 5675*
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Wharfedale

WIRELESS WORKS

BRADFORD ROAD · IDLE · BRADFORD · YORKS

Phone : Idle 1235/6 (2 lines). Grams : Wharfdel, Idle, Bradford.

PRICES (TAX FREE)

W15/CS sand-filled Enclosure	£47	0	0
Treble Assembly	£16	10	0
HS/CR3 Crossover with V.C.'s	£8	10	0
	£72	0	0

2 Sand-filled Back Panels (40in. x 24in.) to complete the enclosure, where a suitable corner is not available, can be supplied at £12 per pair.

WE OFFER TO FOREIGN BUYERS ONLY

SCR-720-C

SEARCH RADAR SETS

ABSOLUTELY COMPLETE AND NEW

Each set is tested to highest military specifications.

ENQUIRIES INVITED

We can supply practically every kind of U.S.A. made Government surplus electronic material, either new and tested, or "as is." We solicit your enquiries.

ALTHAM RADIO COMPANY,
JERSEY ST., MANCHESTER, 4, ENGLAND

PIN-POINT PRECISION

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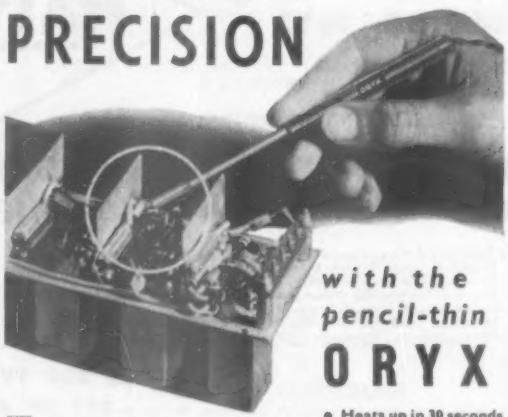

with the pencil-thin

ORYX

The special service, sub-miniature soldering instrument for small assemblies. Pencil-thin for complete control, pin-point precision. Weight — ½ oz. Voltage ranges 6-6½, 12-13 and 24-27½.

• Heats up in 30 seconds • "Pin-point" heat concentration • "Finger control" Soldering • Ample heat-capacity for production lines • Interchangeable push-on bits.

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PREMIER RADIO Company

(R.S.D.) B.H. MORRIS & CO. (RADIO), LTD. EST. 40 YRS.

(Dept. W.W.) 207 · EDGWARE ROAD · LONDON · W2

Terms of Business :- Cash with order or C.O.D. over £1. Please add 1/- for Post Orders under 10/-, 1/6 under 40/-, unless otherwise stated.

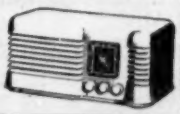
BUILD A PROFESSIONAL LOOKING RADIO AT LESS THAN HALF TODAY'S PRICE

We can supply all the parts to help you.

Drum (2½in. dia.)	1/6
Driving head	1/6
Double pointer	4d.
Spring	3d.
Nylon Cord (yard)	6d.
Dial Front Plate	2/6
Engraved Glass Dial 180-550 and 800-2,200 m.	2/6
With station names, new wavebands	1/6
T.R.F. Coils, 180-550, 800-2,200 metres, pair	5/6
Punched chassis, 3-valve plus rectifier T.R.F.	3/9
Cabinet, Bakelite, in Walnut or Ivory or Wooden in Walnut Finish	17/6
Packing and Insurance	2/6

SEND 1/6 FOR EASY TO FOLLOW POINT-TO-POINT DIAGRAMS AND CIRCUIT DIAGRAM which shows how YOU can build the Receiver illustrated above.

THE COMPLETE KIT to construct a 3-valve plus rectifier T.R.F. Receiver for use on 200/250 v. A.C. mains can be supplied at **£5/15/0**, plus 2/6 packing and carriage. Each Kit is complete in every detail, nothing has to be made or improvised. Easy to follow, point-to-point diagrams are supplied, making construction very simple. The Dial is illuminated, and the Receiver housed in its Cabinet, size 12in. × 8in. × 6in., presents an attractive appearance. The valve line-up is : 717A—HF. Pentode VR116 — Detector, ATP4 — Output, and Metal Rectifier. Waveband coverage for the medium and long bands. Choice of 3 Cabinets: Bakelite in Walnut or Ivory, or Wooden (Walnut finish).



MANUFACTURER'S SURPLUS STOCK

5-VALVE SUPERHET RADIO RECEIVER CHASSIS, built to high standards ensuring quality reception. SPECIFICATION:—VALVE LINE-UP: 7S7, 7B7, 7C6, 7C5, 7Y4, 3 WAVEBANDS Long, medium and short. CONTROLS: Tuning, wave change, volume tone control on/off/Gram.Position on Switch. Pick-up and Extension Speaker Sockets incorporated. For use on 200/250 v. A.C. mains. DIMENSIONS: Length 14½in., height 11½in., width 6½in. Distance between controls, left to right from edge of chassis: 1½in., 6½in., 6½in., 3in. Plus 5/- pkg./carr./ins. The above Receiver's less Speaker and Output Transformer. A suitable 10in. Moving Coil Speaker and Output Transformer can be supplied at 29/- extra.

£7.19.6

LIMITED QUANTITY

1132A RECEIVER UNITS

COMPLETE WITH CIRCUIT

11-valve Superhet Receiver, coverings 100 to 124 Mc/s., using four VR55, two VR56 and VR66, VR67, VR54 and VR57 valves. Fitted with Tuning Meter, slow motion drive, R.F. and I.F Gain. Control, etc. Circuit: R.F. amp. frequency changer, oscillator and stab., 3-IF. amps., B.F.O. Det., first audio and output. Brand new, with circuit diagram.

Price **59/6** *plus 7/6 carriage.*

POWER PACK for above completely wired and tested, will fit on Receiver chassis. Price 50/-, plus 2/6 pkg. and carr.

2 STAGE QUALITY AMPLIFIER

Complete with 10 in. Energised LOUDSPEAKER

4 watts output. A.C. 110/250 mains.

£6 . 19 . 6

plus 5/- carriage.

DECCA MODEL 33A

DUAL SPEED RECORD PLAYER

Includes crystal pick-up with sapphire stylus and a light weight plastic spring balanced arm. Heavy gauge pressed steel case with brown enamel finish in good quality for operation on A.C. mains 200/250 v. 50 c.p.s. Supplied complete with single head (either standard or long playing). **£4.19.6**. Extra Head can be supplied for 19/6. Plus pkg. and carr. 5/-.

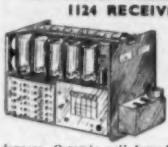
EX-U.S.A. U.H.F. AERIAL

with untuned detector stage, consisting of V.R.92 valve, etc. Brand new, in carton, 5/-.

MAINS NOISE ELIMINATOR KIT

Two specially designed chokes with three smoothing condensers with circuit diagrams. Cuts out all mains noise. Can be assembled inside existing receiver, **5/6** complete.

1124 RECEIVER UNITS



Range 20 to 40 Mc/s. Contains six new Valves 3-9D2, 1-8D2, 1-15D2 (frequency changer), 1-4D1, 24 ceramic trimmers, 6 ceramic valveholders, 6 valve screening cans, 30 resistors, 1-W/W Pot. Meter Mica Tubular and Block Condensers, Ceramic coil former. 2 Westector WX6 and 1 Westector WX4, 5-way 4-bank switch with long spindle, I.F. transformers, etc.

17/6 plus 3/6 postage and packing.

1155 RECEIVER UNIT

SLIGHTLY SOILED

In original cases complete with 10 valves. Frequency range 18.5 Mc/s.-75 Kc/s. in 5 wavebands. **£7/19/6.** Plus 10/6 packing and carriage.

POWER SUPPLY UNIT

for above, incorporating output stage. Supplies an output of 250 volts at 80 mA. which is ample for the R1155 with the output stage. Jones plugs for connecting the Power Pack to the Receiver are included. The 6V6 output stage complete with Output Transformer and 6½in. speaker is built into the unit. Price **£5/5/-**, plus 5/- packing and carriage.

We have a few Brand new R1155 Receivers in original cases, complete with 10 valves. Frequency range 18.5 Mc/s.—75 Kc/s in 5 wave bands. PRICE £11/19/6. Plus 10/6 pkg. and carr.

As a special offer, power supply unit including speaker together with R1155 receiver. PRICE £16.19.6. Plus 15/- pkg. & carr.

R1355 RECEIVER AMPLIFIER

with 5 I.F. Stages for T.V. conversion. Contains 7 VR65's, 1—5U4, 1—VU150, 1—EA50, **£1/19/6.** Plus pkg. and carriage 10/-.

RF 25 UNITS

Frequency covered 40-50 Mc/s (6-7.5 metres), switched tuning. 5 Pre-set positions complete with 3 VR65's. **17/6**, plus pkg. and carr. 2/6.

RF 26 UNITS

The ideal short-wave converter for T.V., variable tuning, contains 2—EF54, 1—VR137, **37/6.** plus pkg. and carr. 2/6.

As a special offer we can supply the R1355 complete with RF24 or RF25 at 50/6 or with RF26 at £4/17/0 plus carr.

R1136 RADAR RECEIVER UNIT

Containing 19 valves, 6—VR65, 2—6J7G, 2—VR116, 2—6Q7G, 1—VR54, 1—VR137, 2—VR136, 1—VR92, 1—5Z3G, the Unit incorporates an R.F. strip followed by an IF strip. **£5/7/6**, plus pkg. and carr. 10/-

CORRECT ASPECT WHITE

Rubber Mask—Round or Flat

6in.	8/6	9in.	9/6
12in.	16/11	15in.	27/6

T.V. PRE-AMPLIFIER

Amplifier Unit Type 209A using 2-VR91 valves suitable for operation on London frequency. Brand new. Plus 1/6 pkg. and carr. **19/6**

ONLY A FEW LEFT—BUY NOW!

THE FAMOUS 'SOBELL' 4-VALVE SUPERHET TABLE RECEIVER

M. & L. WAVEBANDS

Valve line-up: 1R5, 1S5, 1A7, 3S2A. Entirely transportable and unusually sensitive owing to special feed-back circuit employed. Housed in attractive plastic cabinet. Choice of 2 colours—Brown and Cream. Carrying handle incorporated in design. For use on 200/250 A.C./D.C. mains. **£8.8.0**

Plus 5/- Pkg./carr./Ins.

Fully covered by Manufacturer's Guarantee

LIMITED QUANTITY ONLY AVAILABLE AT GREATLY REDUCED PRICE

The FAMOUS 'ROBERTS' M.4.D.

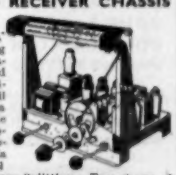
All Dry Battery Portable (Ex-R.A.F.)

This is a 4-valve superhet Receiver covering medium and long wavebands. Built-in Aerial. Housed in a superbly finished rexine covered case. Brand new in manufacturers' original carton. **£10.10.0**

plus 7/6 pkg./carr./ins. (Complete with Battery 17/6 extra).

A WORLD-FAMOUS *Manufacturer's Surplus of* RADIO RECEIVER CHASSIS

7-valve RECEIVER



Built to exacting specifications and incorporating features ensuring superlative tonal qualities and world-wide reception. Specification: 8 watts push-pull output using 2 Mazda Pen. 45 valves. Ample negative feedback is applied over all the audio-amplifier. Amplifier Mazda Type HL41DD gives signal Detection A.V.C. and Phase Splitting. Two stages of I.F. amplification 465 Kc/s., using Mazda VP41.

FOUR WAVEBANDS—14 M.-34 M., 24 M.-65 M., 190 M.-600 M., 900 M.-2,000 M.

DIRECT AND VERNIER TUNING. Gram. position on switch. Provision for external Loudspeaker. For use on 200/250 A.C. Mains. **£13/10/-**, plus 21/- pkg. and carr.

Famous Manufacturer's Surplus of

ANTI-INTERFERENCE AERIALS

offered at a fraction of original cost

The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long/medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wave bands. The equipment enables the installation of an 8.3 Mc/s flatly-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable

COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising one each: Aluminium transformer, Transformer clip, Rubber sucker, ¼in. × ¼in. brass screw. 4AB × ¼in. brass bolt, 4BA nut.

Receiver Transformer. Complete with Insulators, clips etc.; Porcelain Insulators 2 each, 50ft. Insulated Aerial Wire, 60ft. Screened Co-Axial Down Lead.

Installation instruction leaflet included.

LF58 CO-AXIAL CABLE & AERIAL WIRE. 15/-, plus 1/6 pkg. and carr.

COMPLETE 35/-, plus 1/6 pkg. and carr

ROTARY CONVERTER POWER SUPPLY UNIT

12 v. D.C. Input, 230 v. 30 mA. Output. Completely smoothed. Complete with case. **19/6**, plus p/p. and carr. 5/-.

PREMIER RADIO COMPANY

MAY BE BUILT FOR

£31 · 19 · 7

including all valves.
(plus cost of CRT)

THE COMPLETE TELEVISOR IS SAFE TO HANDLE, BEING COMPLETELY ISOLATED FROM THE MAINS BY A DOUBLE WOUND MAINS TRANSFORMER. ALL PRESET CONTROLS CAN BE ADJUSTED FROM THE FRONT, MAKING SETTING UP VERY SIMPLE.

The NEW
PREMIER TELEVISOR

Three years ago we gave you the 6in., 9in. and 12in. Televisors which achieved tremendous popularity. Now after a considerable period of research our Technical Staff have designed a very worthy successor to these original Models.

Brief Technical Details are as follows:
20 valves (plus tube) Superhet Receiver, tunable from 40-68 Mc/s without coil or core changing. Wide Angle scanning Flyback EHT giving 14 kV, Duomag Focaliser permanent magnet focussing with simple picture centring adjustments, suitable for any 17in. or 14in. wide angle Tube, may also be used with a 12in. Tube with very minor modifications.

VISION CIRCUIT. Common RF Amplifier, single valve frequency changer, two IF stages, Video Detector and Noise Limiter followed by special type of Video Output Valve. ALL COILS PRE-TUNED ASSURING ACCURATE ALIGNMENT AND EXCELLENT BAND-WIDTH.

SOUND CIRCUIT. Coupling from anode of frequency changer, two IF stages, Double Diode Triode detector and first LF Amplifier, Diode Noise Limiter and Beam type Output Valve, feeding a 10in. Speaker. ALL COILS PRE-TUNED.

TIME BASES. 2 valve sync. Separator, giving very firm lock and excellent interlace.

LINE TIME BASE. Blocking Oscillator using a pentode driving a high efficiency output stage comprising Ferroxcube Cored Output Transformer with Booster Diode.

FRAME TIME BASE. Blocking Oscillator driving a Beam Output Valve coupled through a Transformer to the high efficiency FERROX-CUBE Cored Scanning Coils.

POWER PACK. Double wound Mains Transformer supplying all L.T. and H.T. using two full-wave Rectifiers.

The Televisor may be constructed in 5 easy stages: **(1) Vision, (2) Time Base, (3) Sound, (4) Power Pack, (5) Final Assembly.** Each stage is fully covered in the Instruction Book, which includes layout, circuit diagrams and **point-to-point** wiring instructions.

The Instruction Book also includes full details for converting existing Premier Magnetic Televisors for use with modern wide angle tubes. All components are individually priced.

Instruction book 3/6, Post Free.

PRICE **£13 · 10 · 0**
plus 21/- packing & carriage.

PREMIER TELEVISOR
CONSOLE CABINETS
For 14" and 17" Televisors

A handsome Walnut Cabinet that will be a fitting housing for a first-class Televisor.
Primarily designed for our own Televisor, they are quite suitable for most designs published in the various Radio Periodicals. Folding doors are fitted to cover the Cathode Ray Tube when not in use. A flap is provided which gives access to any preset controls on the front edge of the Chassis. A baffle board suitable for a 10in. Loudspeaker and all the necessary Tube and Chassis bearers are included. The overall dimensions of both Cabinets are the same: Height 38½in. Width 19in. Depth Top 19in. Depth Bottom 21in.

TUBE ESCUTCHEONS

17in. White Moulded	**21/-**	*(packing and postage 1/6)*
17in. Bronze Moulded, Complete with Protective Glass.....	**48/-**	*(packing and postage 2/6)*
14in. Black Moulded	**7/6**	*(packing and postage 1/-)*
Dark Screen Filter suitable for 14in. or 17in. Tubes.....	**19/6**	*(plus 1/6 packing and postage).*

PREMIER RADIO COMPANY

WHY PAY MORE?

WILLIAMSON AMPLIFIER KIT **15gns.**
plus 7/6 post, pkg. & ins.
This kit is absolutely complete and all components are guaranteed exactly to author's specification.

WILLIAMSON OUTPUT TRANSFORMER
(author's spec.), 3.6 ohms, sec. **£4.4.0**

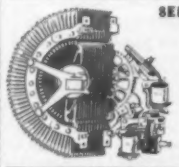
MAINS TRANSFORMER SP425A (with additional 6.3 v 3 a. and capable of supplying an extra 50 mA. for Pre-amp. or Feeder Units) **£3.7.6**

PREMIER MAINS TRANSFORMERS

All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened. All LTs are centre tapped.

SP178B, 175-0-175, 50 mA., 4 v. @ 1 a., 4 v. @ 2-3 a. **25/-**
SP350A, 250-0-250, 100 mA., 6 v. @ 2-3 a. 6.3 v. @ 2-3 a. **29/-**
SP351, 350-0-350, 150 mA., 4 v. @ 1-2 a. 4 v. @ 2-3 a. 4 v. @ 3-6 a. **36/-**
SP352, 350-0-350, 150 mA., 5 v. 2-3 a. 6.3 v. 2-3 a. 6.3 v. 2-3 a. **36/-**
SP375A, 375-0-375, 250 mA., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-3 a. **55/-**
SP501, 500-0-500, 150 mA., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 3-5 a. **47/-**
SP501A, 500-0-500, 150 mA., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a. 6.3 v. @ 2-3 a. **50/-**
SP425A, 425-0-425, 200 mA., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-5 a. **67/6**
250-0-250, 80 mA., 6.3 v. @ 4 a. 5 v. @ 2 a. **19/6**
350-0-350, 80 mA., 6.3 v. @ 4 a. 5 v. @ 2 a. **19/6**
200-230-250, output 3 v.-30 v. @ 2 a. .. **17/6**

SELECTOR SWITCHES



For many uses, including station selection on a Pre-tuned Radio Receiver.
16 way, 56 Position.
24 v. motor driven.
Price **69/6**
Plus 2/6 Pkg. & Carr.

PREMIER VARIABLE IMPEDANCE "MATCHMAKER" M.O.15 OUTPUT TRANSFORMER

Designed to meet the demand for an efficient variable ratio Output Transformer. 11 ratios from 12 : 1 to 80 : 1 all centre tapped and can be used to match any output valves either single- or push-pull. Class "A" "AB1" "AB2" or "B" to say low impedance speech coil or combination thereof. Primary Inductance 60 henries 15 watts audio 100 mA. Price **45/-**.

WEYMOUTH MINIATURE I.F. TRANSFORMERS

465 Kc/s., iron cored, permeability tuned, **10/6** pair.

WEYMOUTH MINIATURE COIL PACK

Covering Med./Long/Short wave bands. Iron cored coils, gram position on switch. Dimens.: Height, 1¾in. Length, 3¼in. Width 2¼in. Spindle length 2in. Price **19/6**.

MINIATURE TUNING CONDENSERS

2 gang .0005 mfd. with trimmers **6/9**

CHARGER TRANSFORMERS

Input 230 v. A.C. Output 12 v. at 1 amp. Completely shrouded. Price **9/11**

BATTERY CHARGERS

200-250 v. A.C. Will charge 2 v., 6 v. and 12 v. Car Battery at 1 amp. Housed in strong metal casing. Finished in Green hammered enamel. Size: 6in. long, 3¼in. wide, 3¼in. high. Guaranteed 12 mths. The above unit is manufactured by PREMIER and does not contain ex-Govt. components. Plus 2/6 post and pkg. **39/6**

BATTERY CHARGER KITS

All incorporate metal rectifiers. Transformers are suitable for 200/250 v. A.C. cycle mains.
Cat. No.
2002 Charges 6 volt accumulator at 1 amp. Resistance, supplied to charge 2 v. accumulator **21/-**
2004 Charges 2, 6 and 12 v. accumulators at 1 amp. **24/6**

7-VALVE SUPERHET CHASSIS

All control mountings cut out, fitted with completely assembled full vision drive scale, long, medium and short waveband and band spread. Heavy flywheel tuning. **19/6**, plus 2/6 pkg. and carr.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT

All parts to construct an eliminator to give an output of 120 volts at 20 mA., and 2 volts to charge an accumulator. Uses metal rectifier, **37/6**.

C.R. TUBES

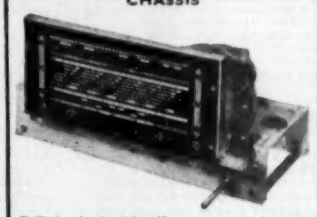
VCR516
9in. Blue picture, Heater volts 4 Anode 4 Kv. In manufacturer's original carton.
£3/19/6. Plus 5/- pkg., carr., ins.

VCR517C **ALL BRAND NEW**
6¼in. picture. This tube is a replacement for the VCR97 and VCR517. Guaranteed full size picture.
Price 35/- Plus 2/6 pkg. carr. ins.

AUTO TRANSFORMERS 50 WATTS

Input/Output 0-110-210-220-230-240-250 volts. Plus 1/- P. & P. **7/6**

5-VALVE SUPERHET RADIO CHASSIS



Drilled and cut out for all necessary control mountings and Mains Transformer, fitted with 5 Amphenol Octal Valveholders, Aerial, Earth and Gramophone Sockets. 500 pf Tuning Gang Condenser, full vision drive Tuning Assembly consisting of unbreakable Perspex 3-coloured scale for long, medium and short wavebands. Calibrated in metres, kilocycles and station names, price **39/6**.

SPECIAL OFFER
THE *FAMOUS* "CHANCERY" HIGH FIDELITY MICROCELL PICK-UP—TYPE GPX *for Standard and Long Playing*

The Chancery Light Weight G.P.X. Pick-up which has a sapphire stylus which is precision ground and *mounted*-permanently. With two cartridges 1 L.P. and 1 Standard. **Price 52/6.** *Additional L.P. or Standard Cartridges can be supplied from stock at* **19/6** *each.*

★ **QUALITY CRYSTAL PICK-UP ROTHERMELL TYPE U48 20/-** plus 1/6 Pkg. and Carr.

PORTABLE GRAMOPHONE UNIT

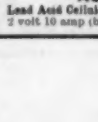
Ready to plug into Radio or Amplifier. Fitted with B.S.R. 2-speed motor 33⅓ and 78 r.p.m. and Chancery high fidelity microcell pick-up type G.P.X. with L.P. and Standard Cartridge. Assembled in rexine covered cabinet. Height 5¼"; Length 15¼"; Depth 13½". Price **£7.7.0** plus 5/- Pkg. & Carr.

Cabinets can be obtained separately at **20/6** plus 2/6 Pkg. & Carr. Carrying handle and clips are supplied free.

THE COLLARO RC/521 3-SPEED AUTOMATIC RECORD CHANGER

Magnetic Studio head transformer included. Motor suitable for 100/125v. or 200/250v. Play either 7" or 10" or 7" and 12" not mixed.
Price **£9.19.6**
Plus 5/- Pkg. and Carr.

GARRARD Rim Drive 78 r.p.m., complete with magnetic pick-up and turntable **£5.19.6**
COLLARO 3-speed single-gram. unit, complete with head for L.P. and Standard recordings **£6.19.6**
Packing and carriage on each of the above units **2/6**.



"MASTERADIO" VIBRATOR PACK

6 v. input; 150 v. 60 mA. output; complete with valve rectifier and leads. **39/6.** Plus 5/- pkg., carr.

ACCUMULATORS

Lead Acid Celluloid Non-Spill, 2 v., 7 amps..... **9/6**
2 volt 10 amp (by famous maker) **4/11**

RECTIFIERS

E.H.T. Pencil Type 2.T.C.

Type K3/25	650 v.	1 mA.	4/7
" K3/40	3.2 kV.	1 mA.	6/-
" K3/45	3.6 kV.	1 mA.	9/2
" K3/50	4 kV.	1 mA.	8/8
" K3/160	12 kV.	1 mA.	21/6

H.T. Type 2.T.C.

Type RM1	125 v.	60 mA.	4/-
" RM2	125 v.	100 mA.	4/6
" RM3	125 v.	125 mA.	5/6
" RM4	250 v.	250 mA.	18/-

L.T. Type Full Wave

6 v. 1 amp.	4/-
12 v. 1 amp.	8/-
12 v. 2 amp.	10/9
12 v. 4 amp.	15/-

A.C.R.I. C.R. TUBES

5¼in. screen. 4 volt Heater. This Electrostatic Tube is recommended as eminently suitable for Television. **15/-** plus 2/6 Pkg., carr. and ins. Data sheets supplied.

SUPER QUALITY TELEVISION MAGNIFYING LENS

8in. lens suitable for 6in.	18/6
6in. lens	25/-
10in. lens	£2/10/-
12in. lens	£3/10/-

ALUMINIUM CHASSIS 18 s.w.g.

Substantially made from Bright Aluminium, with four sides

7 × 5½ × 2in.	4/-
7 × 3½ × 2in.	3/9
9½ × 4½ × 2in.	4/3
10 × 8 × 2½in.	5/6
12 × 9 × 2½in.	7/-
14 × 9 × 2½in.	7/6
10 × 9 × 3in.	7/-
12 × 10 × 3in.	7/9
14 × 10 × 3in.	7/11
16 × 10 × 3in.	8/3
16 × 8½ × 2½in.	8/-

ALUMINIUM PANELS 18 s.w.g.

7 × 6in.	1/3	7 × 4in.	1/-
9½ × 6in.	1/6	9½ × 4in./	1/5
10 × 9in.	2/2	10 × 7in./	1/11
12 × 9in.	2/6	12 × 7in.	2/5
14 × 9in.	3/2	14 × 7in.	2/11
16 × 9in.	3/6	16 × 7in./	3/5
20 × 9in.	4/8	20 × 7in.	4/5
22 × 9in.	5/2	22 × 7in.	4/11

LOUDSPEAKERS

ELAC—2½in. dia., Moving Coil, 15 ohms imp. **15/-**
PLESSEY—3in. dia., Moving Coil, 3 ohms imp. **15/-**
ELAC—3½in. dia., Moving Coil, 3 ohms imp. **15/-**
ELAC—5in. dia., Moving Coil, 3 ohms imp... **14/6**
ELAC—8in. dia., Moving Coil, 3 ohms imp. **17/6**
PLESSEY—8in. dia., Mains Energised, 3 ohms imp. (600 ohms field), with Pentode Transformer **22/6**
PLESSEY—8in. dia. Mains Energised, 3 ohms imp. (600 ohms field) **19/6**
PLESSEY—10in. dia. Moving Coil, 3 ohms imp. **23/6**
GOODMANS—12in. dia., Moving Coil, 15 ohms Plus 5/- packing and carriage. **£8/8**
VITAVOX—K12/20 12in. dia., Moving Coil, 15 ohms imp. **£11/11**
Plus 5/- packing and carriage.

SPECIAL OFFER
A 12in. TRUVOX P.M. SPEAKER
(2-3 ohm Voice Coil) For only
These are brand new in Maker's Cartons **49/6**
Plus **2/6** *Pkg. and Carr.*

METERS

Large stocks available, a few of which are enumerated below:—

Full Scale Deflection	Scale Length in.	External Dimensions in.	Movement	
25 A	1½	2½ round	R.F. Thermo	7/6
3.5 A	1½	2½ × 2½	R.F. Thermo	7/6
4 A	1½	2½ × 2½	R.F. Thermo	7/6
20 A	1½	2½ round	M/C	8/6
40 A	1½	2½ round	M/C	8/6
1.5 mA	1½	2½ round		12/6
5 mA	2	3½ round		7/6
6 mA	2	3½ round		10/9
50 mA	1½	2½ × 2½	M/C	7/6
20 V	2	2½ × 2½	M/C	8/6
40 V	1½	2½ × 2½	M/C	8/6
1 mA	2	3½ round	M/C	25/-

MOVING COIL METER

A super quality Moving Coil Meter basic movement 2 mA fsd scale dimensions 2½in. Overall dimensions 2¼in. dia. 1¼in. deep. Bakelite Case projecting type. At present scaled 1 amp. R.F. By removing thermo couple, reversing scale and recalibrating the meter, a high grade test instrument with any range above the basic F.S.D. may be built up. Price **4/9**

Germanium Crystal Diodes. O.E.C. wire ended **2/6** **24/-** doz.

PREMIER RADIO COMPANY

The "PREMIER" Recorder

The PREMIER De Luxe **PORTABLE** PRICE **£37·4·0**

MAGNETIC TAPE RECORDING KIT (Plus 15/- Pkg., Carr. & Ins.)

★ *Including ALL parts, Valves, Portable Cabinet, 8 in. Loudspeaker, Tape-Table, Reel of 'Scotch Boy' Tape and Rewind Spool, and Microphone.*

THE 7-VALVE AMPLIFIER IS SPECIALLY DESIGNED FOR HIGH QUALITY REPRODUCTION

Brief Specification: **VALVE LINE-UP**: EF37A First Stage, 6BL7 Second Stage and Tone Control; 6V6 Output 6X5 Rectifier; VT501 Bias and Erase Oscillator; 7193 Record Level Amplifier; 6U5 Magic Eye Record Level Indicator. **OUTPUT**: 4 Watts. **FREQUENCY RANGE**: 50 c.p.s. to 9,000 c.p.s. **CONTROLS**: Volume; Record/Playback Switch; Treble Boost; Bass Boost—on/off.

A VISUAL MAGIC EYE Record Level Indicator is incorporated. The unit is housed in a superbly finished rexine covered portable cabinet which incorporates a compartment for the Microphone when not in use. Weight complete 35lb. Dimensions: 21in. long, 12½in. deep, 9½in. high.

The RECORDER incorporates an entirely NEW VERSION of the famous LANE TAPE TABLE. Brief Specification: Made to high standards and incorporating features ensuring low level of "Wow" and "Flutter" throughout the full length of tape.

FAST REWIND. Provision for fast rewind and forward run in less than 1 min. in either direction. WIND AND REWIND WITHOUT UNLACING OF TAPE. INSTANTANEOUS BRAKING. THREE MOTORS obviating friction drive.

HIGH FIDELITY RECORD PLAYBACK (1 HOUR APPROX. PLAYING). The Table is fitted with high fidelity record playback head of new design wound to high impedance and a separate A.C. Erase Head. The Heads are half-track size allowing approx. 1 hr. playing from standard 1,200ft. Reel of Tape.

TAPE SPEED: 7½in. sec. **For use on A.C. 200/250, 50 cycles mains only.**

MICROPHONE: Crystal—specially designed for Premier by famous manufacturer.

This Recording Outfit has been designed for use with M.C.-2-111 "SCOTCH BOY" Magnetic Tape. With this new and improved high-quality tape a frequency of 50 c.p.s. to 9,000 c.p.s. at tape speed of 7½ in./sec. can be readily achieved. Additional reels of 1,200ft. can be supplied at 25/-

INSTRUCTIONAL BOOKLET . . . 2/6
This is credited if a complete kit of the Tape Recorder is ordered.

As is usual in all PREMIER KITS every single item down to the last nut and bolt is supplied. The Chassis is punched and layout diagrams and theoretical circuits are included.
When completed the PREMIER PORTABLE TAPE RECORDER compares MORE than favourably with any other make at double the price.

SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW

AMPLIFIER KIT (including 8in. Speaker)	£11 0 0	plus 5/- pkg./carr.
AMPLIFIER (already built, wired and tested)	£14 15 0	plus 7/6 pkg./carr.
LANE TAPE TABLE & REWIND SPOOL	£16 10 0	plus 7/6 pkg./carr.
PORTABLE CABINET (rexine covered)	£4 19 6	plus 5/- pkg./carr.
MICROPHONE	£2 19 6	plus 1/- pkg./carr.
REEL OF NEW M.C.-2-III "SCOTCH BOY" TAPE (1,200ft.)	£1 15 0	plus 1/- pkg./carr.

To those unable to build this PORTABLE TAPE RECORDER we can supply it completely wired, tested and ready to plug in at **39GNS**
Plus 1 gn. pkg./carr.

CRYSTAL MICROPHONE
An entirely insulated crystal microphone which can be safely used on A.C./D.C. amplifiers. High impedance. No background noise, really natural tone. The ideal Mike for tape, wire and sound projectors. Price **£2/6**

MICROPHONE STAND BASE
Heavy Moulded Black Base fitted with Standard thread adaptor. Dimensions: 7½in. across, 2in. deep. Weight: 1¼lb. Foot pad 2/11.

SPECIAL OFFER

CRYSTAL HAND MICROPHONE
High impedance. Excellent frequency response, light weight. Gives very high quality results when used with tape recorder, amplifier for any type of P.A. equipment. Complete with screen lead and plug *Plus 1/6 Pkg. & Carr.* Price **22/6.**

MICROPHONES
LUSTRAPHONE: Moving Coil; High Impedance. Stand Type: **£5/15/6**—Hand Mike **£6/6/0.**
RONETTE—Crystal Mike; Incorp. the Filter Cell Insert; High Imped. Ball Type: **£3/19/6.**
CRYSTAL MICROPHONE—Rothermel 2AD56. Especially recommended. **£2/19/6.**
Table stands for all the above 10/6 and 17/6.

Quartz Crystals of any shape and size cut and ground precisely to specification and coated, if required, with Gold, Silver, Aluminium or Rhodium, etc.

BROOKES CRYSTALS LTD.
Suppliers to Ministry of Supply, Home Office, B.B.C., etc.
EARLSWOOD STREET, GREENWICH, LONDON, S.E.10
Phone: Greenwich 1828
Grams: Xtals Green, London. Cables: Xtals, London.

Television · Radio · Record
CABINETS MADE TO ORDER

ANY SIZE OR FINISH

CALL OR SEND DRAWINGS FOR QUOTATION

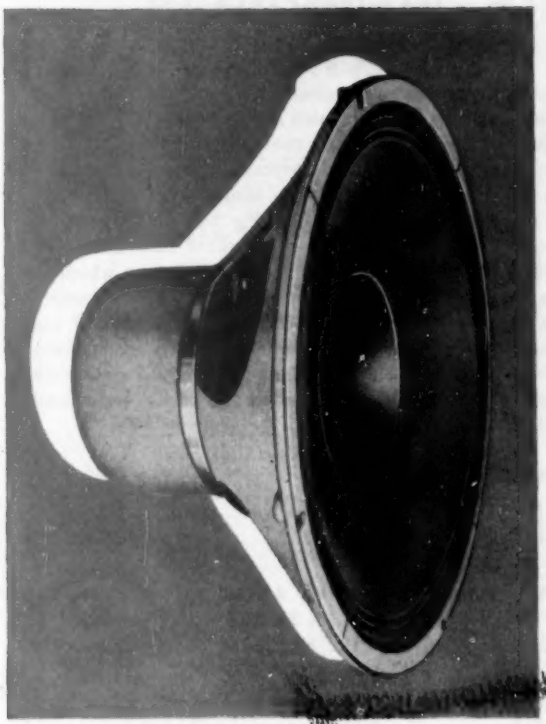
B. KOSKIE (DEPT. E.)
72-76 Leather Lane, Holborn, E.C.1
Phone: CHAncery 6791/2

MINIATURE MAGNETIC LIGHTWEIGHT EARPHONES

The AMPLIVOX E.4, E.5 and E.6 provide a range of highly sensitive lightweight miniature receivers. Ideal for many applications, the inserts have been incorporated in lightweight headsets, stethoscope devices and small microphones.
The E.6 is the smallest of the range, the diameter is 0.835", depth 0.332" and weight ½oz. D.C. resistance E.4 & E.5 2-2,000 Ω, E.6 1-600 Ω.

AMPLIVOX LTD.
2 Bentinck Street, London, W.1.

Sound Appreciation from the U.S.A.



Goodmans High Fidelity and good quality Commercial loudspeakers give pleasure to discriminating listeners everywhere. From the U.S.A. comes the appreciation of high quality sound reproduction, typical of hundreds in its enthusiasm.

Clifton, New Jersey U.S.A.
20th November, 1953.

Dear Sirs,
Your Model AXIOM 150 Mk II. Loudspeaker has provided me with tremendous pleasure and its performance has never been short of perfect. In my opinion I think it is the finest over innumerable other speakers.

The purpose of writing you is of course to thank your firm for the splendid enjoyment brought true to life by your AXIOM 150 Mk II speaker. During the past few months flaws have popped up in both amplifier and tuner but the speaker has continued to perform brilliantly without mishap

AXIOM 150 MK. II

BRIEF SPECIFICATION

Frequency Coverage	30/15,000 c/s
Fundamental Resonance	35 c/s
Max. Power Capacity	15 watts peak A.C.
Flux Density	14,000 gauss
Finish	Grey Rivelling Enamel
Price	£10 . 5 . 6 (Tax free)

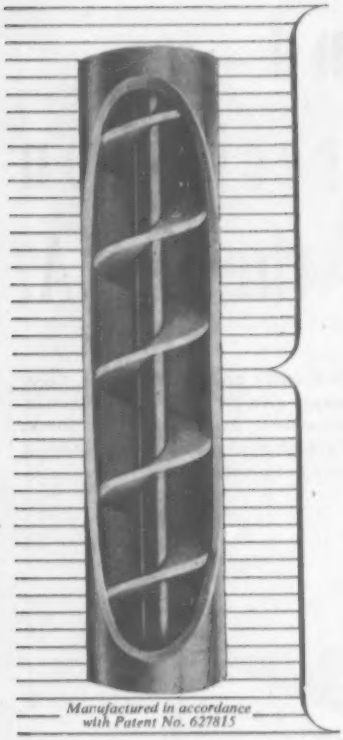
This is but one of the numerous unsolicited testimonials which are continually reaching us, the originals of which are available for inspection.

Dimensional drawings of a specially designed Corner Reflex Cabinet measuring approximately 46" x 29" x 19", and illustrated literature covering the full range of Goodmans Loudspeakers will be sent on request.

GOODMANS INDUSTRIES LIMITED
AXIOM WORKS, WEMBLEY, MIDDLESEX

GOODMANS

Telephone : WEMbley 1200 Cables : Goodaxiom, Wembley, England



Manufactured in accordance with Patent No. 627815

HELICAL MEMBRANE COAXIAL CABLES

The Helical Membrane cable was developed primarily for radio-frequency applications to provide a highly efficient construction which would not have the same frequency limitations as disc-spaced cables. The insulation is comprised of a thin Telcothene* tape spirally wound edge-on around the inner conductor. A practical method of achieving this basic form of the insulation was sought unsuccessfully for many years until Telcon succeeded in overcoming the difficulties involved. In the practical form which has been realised, the effective permittivity is as low as that of any commercial form of disc-spaced cable whilst tests indicate that an extremely high degree of uniformity has been achieved. In combination with an aluminium sheath as an outer conductor and a watertight covering, it has electrical characteristics closely approaching the optimum and yet is mechanically robust and reliable.

Please ask for publication HM/2

**Telcothene (Regd.) is polythene processed by Telcon to provide specific characteristics.*

TELCON RF cables

THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD

Works: Telcon Works, Greenwich, S.E.10. *Tel: GREenwich 3291*

Branch Office: 43 Fountain Street, Manchester 2. *Tel: Central 0758*

Harvey Electronics Limited announce their new

BULK ERASER

Trade enquiries invited

for ½" Magnetic Tape. Ideal for quick cleaning of all ½" standard tape enabling each recording to commence with an absolutely clean tape.

Send for pamphlet and full details from: **PRICE £6. 15s.**

HARVEY ELECTRONICS LTD.,
273, FARNBOROUGH ROAD, FARNBOROUGH, HANTS.
Tel.: Farnborough 1120
LONDON Office: 59, Union Street, S.E.1. *Tel.: HOP 4567*

TELEVISION

for "Fringe" and "Long distance" viewers is vastly improved with the SPENCER-WEST type AC/3 Pre-Amplifier. The specification includes a first stage neutralised triode cathode coupled to a grounded grid triode. The optimum arrangement for best "noise factor." Self-contained power supply unit complete with correctly adjusted interference filter. Price complete, 10 gns. from your dealer or direct. Leaflets, etc., on request.

RECEIVER CONVERSION TO NEW CHANNELS

The type AC/4 Converter units for perfect simple conversion. Price complete with 5 valves and self-contained power unit, etc. 15 gns. Available for Brighton booster on London receivers (type AC/4KL) and all other conversions. Leaflets on request

SPENCER-WEST
QUAY WORKS, GT. YARMOUTH
Phone: Gt. Yarmouth 3009

TYPE APPROVED VITREOUS WIRE WOUND RESISTORS — QUICK DELIVERY LOW PRICE

Labgear (Cambridge) Limited
WILLOW PLACE, CAMBRIDGE, ENGLAND
Telephone: CAMBRIDGE 2494 (2 lines) Telegraphic Address: "LABGEAR, CAMBRIDGE"

CLASSIC EXAMPLES of HIGH-FIDELITY EQUIPMENT and COMPONENTS

The outright purchase of equipment can be a heavy item, but that is no reason why you should not straight away have the best of gear available by Classic H.P. Here are a few examples showing deposits in relation to the full cash purchase price.

TAPE RECORDERS ETC

		PRICE	DEPOSIT
	COMPLETE INSTRUMENTS	£ s. d.	£ s. d.
580/1	Ferrograph Model 2a (as available)	70 10 0	27 0 0
580/2	G.B. Standard	99 10 0	33 5 0
580/A	Vortexion with Wearite Deck	84 0 0	28 0 0
581/2	Grundig 2-speed	84 0 0	28 0 0
581/8	R.M.C. with new Lane Tape Desk	47 10 0	16 0 0
	TAPE DESKS		
585	Lane Mark IV	17 10 0	6 0 0
586	Truvox, Mark III*	23 2 0	8 2 0
587/1	Wearite, Type 2A*	35 0 0	12 0 0
587/2	Wearite, Type 2B*	40 0 0	14 0 0
588/1	Bradmatic, Type 3 and 5RP*	41 0 0	14 0 0
588/2	Bradmatic, Type 5c*	45 10 0	15 10 0
588/3	Bradmatic, Type 5/6RP*	42 0 0	14 0 0
588/4	Bradmatic, Type 5CL*	47 10 0	16 10 0
588/5	Bradmatic. Type 5D*	50 0 0	17 0 0

**Equipped for half-tape recording.*

	MICROPHONES	
553	Reslo VMC (Moving-coil)	6 0 0
554	Reslo R.V. Ribbon	9 0 0
557	Grampian Moving-coil	5 17 6
560	Cosmocord Mic/30 Desk Model Crystal	2 10 0
561	Cosmocord Mic/22-1 Acos Crystal	4 4 0
563	Cosmocord Mic/16-2 Acos Crystal	12 12 0
565	Lustraphone C.H.51 Hand Model, Moving-coil	5 15 6
566	Lustraphone L.X.55 Crystal Model	2 10 0

Stands of all types available.

	T.R. AMPLIFIERS		
592/1	Lane Amplifier Kit, K-A.-1/R.P.	13 10 0	4 10 0
592/2	Lane Amplifier Assembled	15 10 0	5 5 0
593/1	Elpico Junior Amplifier	16 16 0	6 0 0
593/2	Elpico Senior Amplifier	24 0 0	8 0 0
594	Bradmatic C.I. with Push/Pull O/P	62 0 0	21 0 0
593	C.J.E.C.P./1 with P/P O/P	24 12 0	8 5 0
595/1	C.J.E. Professional Type P.A.I.	94 0 0	32 0 0
	MOTORS		
520	Collaro Clock and Anti-clockwise	1 18 6	
521	B.S.R. Model S.R.2	1 5 6	
522	B.S.R. Model S.R.1	1 12 0	
523	B.S.R. Model F.P.10	1 18 0	
	T.R. TAPES		
569	Emitape H60/6, 600ft.	1 1 0	
570	Emitape H60/12, 1,200ft.	1 15 0	
570	Emitape H65/12, 1,200ft.	1 15 0	
572	G.E.C. Plastic, 1,200ft.	1 10 0	
573	Gevaert, 1,200ft.	2 0 0	
574	Agfa 1,200ft.	1 17 6	
576	Magnetophon, 1,200ft.	2 0 0	
576	Ferrotape (Wearite), 1,200ft.	2 5 0	
577	Ferrotape (Wearite), 1,750ft., 8in.	3 3 0	

DISK EQUIPMENT

		PRICE	DEPOSIT
	MOTORS AND PICK-UPS	£ s. d.	£ s. d.
	CONNOISSEUR		
400	3-speed motor	21 17 3	7 10 0
400/1	3-speed motor with pick-up and one head	27 16 6	9 5 0
	GARRARD		
401	Autochanger RC 80 less pick-up heads	15 1 6	5 0 0
401/1H	Autochanger RC.75A with 2 Decca XM8 heads	18 17 8	6 5 0
	COLLARO		
402	Autochanger Model 2RC.531, 3-speed less pick-up head	12 3 1	4 5 0
402/6	A.C. Motor 5/534, 3-speed	6 5 4	2 5 0
	DECCA		
403	GU.4C 3-speed motor with crystal turnover pick-up	9 10 0	3 5 0
403/3	Decca transcription motor, 3-speed, Decca XM8 pick-up and 2 heads	23 18 2	8 0 0
	B.S.R.		
405	M.U.10 3-speed motor	3 18 7	1 5 0
405/2	GU.4 3-speed motor with turnover crystal pick-up	9 9 0	3 5 0
	PLESSEY		
406	Plessey 3-speed Autochanger unit, with pick-up. Special price, limited number	10 10 0	3 10 0
	E.M.I.		
407	E.M.I., 3-speed, type 2125	17 2 6	5 15 0
	AMPLIFIERS, TONE-CONTROLS ETC.		
100	Leak, T.12 Standard	28 7 0	9 10 0
101	Quad, with control unit	35 0 0	11 15 0
103	Goodsell M.A.15	19 10 0	6 10 0
104	Rogers Baby de Luxe	14 0 0	4 12 0
150	Leak "Vari-slope"	12 12 0	4 5 0
151	Goodsell Type U/TC	8 15 0	3 0 0
151/1	Goodsell Type F/U/TC	14 14 0	5 0 0
151/2	Goodsell Type F/FA	18 0 0	6 0 0
152	Rogers Junior de Luxe, Mk. II	9 0 0	3 0 0
153	Lowther Master Control Unit	20 0 0	6 15 0
	LOUDSPEAKERS		
	WHARFEDALE		
601/2	W.12	9 5 0	3 5 0
601/2	W.12/C8	9 15 0	3 5 0
601/4	Super 12in./C8/AL	16 0 0	5 10 0
	GOODMANS		
603/1	Axiom 150/2	10 5 9	3 10 0
603/2	Audiom 80 15in.	22 10 0	7 10 0
603	Audiom 60	8 12 8	3 0 0
	TANNOY		
606	Tannoy 12in. Dual Concentric, with built-in crossover network	27 10 0	9 5 0
	LOWTHER VOIGT		
607	Lowther Voigt PM/2 Drive unit	35 0 0	12 0 0
	VOIGT		
606	Voigt P.M. Pressure Unit	42 0 0	14 0 0

The items shown here represent but a small proportion of our regular stock, which includes radio-feeder units, complete radio units etc.

And our vast and varied range of apparatus and equipment, possibly the largest in the country, is backed by the famous Classic pre-sales test scheme, whereby every piece of apparatus is thoroughly tested before despatch and guaranteed by our own highly skilled technicians, thus enabling us to give a firm guarantee.

CLASSIC ELECTRICAL CO LTD

352-364 LOWER ADDISCOMBE ROAD · CROYDON · SURREY TEL · ADDISCOMBE 6061-2

Several more good reasons
why our circle of friends keeps enlarging

Air Cooled, Compound Filled and Oil Immersed Transformers for every requirement

A.I.D. Authority Ref. No.: 6489/53

WILLESDEN TRANSFORMER CO., LTD.,
2a FRITHVILLE GARDENS, SHEPHERDS BUSH, LONDON, W.12.
Telephone: SHEpherds Bush 5819

IF YOUR PROBLEM IS

COIL IMPREGNATION

The BLICKVAC HIGH VACUUM IMPREGNATOR meets the rapidly growing demand for high-vacuum impregnation.

Full range of models available to meet the needs of

★ The large-scale Producer.
★ The Research Laboratory.
★ The small Rewind Shop.

BLICKVAC UNITS MEET THE MOST STRINGENT SPECIFICATIONS.

Outstanding features:
★ Ease in Control. ★ Simple attachment of auxiliary autoclaves. ★ Best quality fittings. ★ Fully demountable to facilitate cleaning.

UNEQUALLED FLEXIBILITY AND PERFORMANCE.

Units available for:
VARNISH BITUMEN
WAX POTTING RESINS

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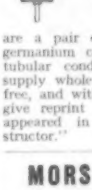

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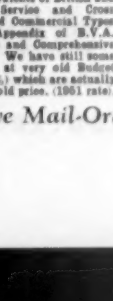

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ECH42	20/2	FL81	16/5
ECL80	23/4	PL82	16/5
EF9	19/6	UBC41	15/1
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Wireless World

RADIO, TELEVISION AND ELECTRONICS

43rd YEAR OF PUBLICATION

Managing Editor : HUGH S. POCOCK, M.I.E.E.
Editor : H. F. SMITH

JANUARY 1954

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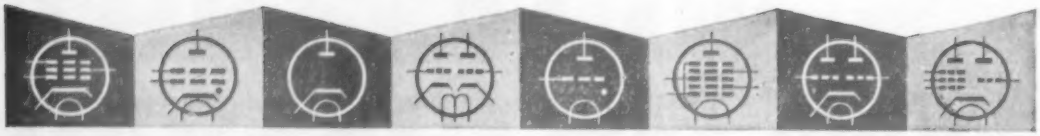

VALVES, TUBES & CIRCUITS

13. OPERATION OF TYPE EL84 OUTPUT PENTODE IN AUDIO AMPLIFIERS

Recent developments in the art of recording music on disc and tape, together with improvements in the quality of sound broadcasting provided by V.H.F. transmissions such as the television service, are leading to increased demands for high fidelity in the amplifier or receiver. To meet this requirement it is desirable to increase the available audio output power and hence decrease the distortion present at a given output.

The new Mullard output pentode, type EL84, has been designed to satisfy these demands, a single valve providing an output power of 5 to 6 watts. Its rated anode dissipation is 12 watts compared with earlier valves such as types EL41 and EL33 which were rated at 9 watts. The EL84 is in the miniature all-glass range having a single-ended construction and a B9A (noval) base. Although the total cathode current under typical conditions of operation is about 55mA, the heater rating is only 6.3V, 0.76A.

With the maximum anode dissipation rating of 12W and a mutual conductance of over 11 mA/V, a signal of very small amplitude is sufficient for full drive; an output of 5 to 6 watts being obtained with a signal of less than 5V r.m.s. When adjusted for operation with an anode dissipation of 9 watts the performance of the EL84 is superior to that of the EL41. In addition this valve may be successfully employed in the output stage of medium power amplifiers, two valves in push-pull giving output powers of up to 17 watts. It is particularly suitable for use in high-fidelity amplifiers rated to deliver outputs of the order of 10 watts.

CHOICE OF OPERATING CONDITIONS. The accompanying table includes operating conditions as a single valve Class "A" amplifier. The first two columns give alternative conditions depending on the choice of anode load. The value of 5.2kΩ is the conventional choice calculated from the quotient of anode voltage to anode current at the working point for 12 watts anode dissipation. Under these conditions the third harmonic distortion at large signals represents a considerable proportion of the total distortion. The ratio of third to second harmonics in the total distortion may be reduced by choosing a lower value of anode load such as the 4.5 kΩ shown in the second column.

The remaining two columns in the table indicate the best methods of using the EL84 as a replacement for the EL41. In one case the screen-grid voltage is reduced to 210 volts compared with 250 volts on the anode. This gives a smaller screen-grid current and a slightly higher mutual conductance than the EL41 but the resulting output power is about the same for the two valves.

The other method of simulating the EL41 conditions consists of applying the same voltage (250V) to anode and screen-grid, and to increase the negative grid-bias to −8.4V by changing the cathode bias resistor. With the higher screen-grid voltage the grid base is increased. Under these conditions the efficiency may considerably exceed 50% before grid current commences to flow but the distortion will then necessarily be fairly large. This method of operation results in the available peak power being extremely high.

VALVE DATA

HEATER

V_h	6.3	V
I_h	0.76	A

CAPACITANCES

c_{out}	6	μμF
c_{in}	11	μμF
c_{a-g1}	< 0.5	μμF
c_{g1-h}	< 0.25	μμF

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
I_a	48	mA
I_{g2}	5.5	mA
V_{g1}	−7.3	V
g_m	11.3	mA/V
r_a	38	kΩ

LIMITING VALUES

V_a max.	300	V
p_a max.	12	W
V_{g2} max.	300	V
p_{g2} max.	2.0	W
I_k max.	65	mA
V_{h-k} max.	100	V

BASE B9A **DIMENSIONS** Max. seated height ... 71 mm. Max. overall length ... 78 mm. Max. bulb diameter ... 22.2 mm.

TYPICAL OPERATION AS SINGLE VALVE CLASS 'A' AMPLIFIER

V_a	250	250	250*	250	V
V_{g2}	250	250	210	250	V
R_a	5·2	4·5	7·0	7·0	kΩ
r_{k}	135	135	160	210	Ω
V_{g1}	−7·3	−7·3	−6·4	−8·4	V
I_a	48	48	36	36	mA
I_{g2}	5·5	5·5	3·9	4·1	mA
$V_{in(r.m.s)}$	4·3	4·4	3·4	3·5	V
†P_{out}	6·0	6·0	4·3	4·2	W
D_{tot}	10	10	10	10	%
D_3	9·5	8·0	9·3	8·7	%
D_2	2·0	5·0	1·8	1·7	%

† Measured with fixed bias. * Operation under EL41 conditions.

TYPICAL OPERATION AS PUSH-PULL OUTPUT STAGE

V_a	250	300 V
V_{g2}	250	300 V
R_k	130	130 Ω
R_{a-a}	8.0	8.0 kΩ
I_a (o)	2 × 31	2 × 36 mA
I_a (max. sig.)	2 × 37.5	2 × 46 mA
I_{g2} (o)	2 × 3.5	2 × 4 mA
I_{g2} (max. sig.)	2 × 7.5	2 × 11 mA
$V_{in\ (g-g)\ (r.m.s.)}$	16	20 V
P_{out}	11	17 W
D_{tot}	3	4 %

Mullard

Reprints of this advertisement, together with additional data, may be obtained free of charge, from the address below.

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MVM 258

Wireless World

JANUARY 1954 VOL. 60 No. 1

Small-Scale Competitive Television

IN spite of much airing of views in prolonged Parliamentary debates, the Government's avowed intentions on the future of television may yet be subject to change. The agreed policy is set out in the latest White Paper,* but the Home Secretary made it plain in his closing speech in support of the document that, when the time comes to prepare legislation, the Government will still be willing to listen to new proposals, always provided they lead to something that will put an end to the B.B.C. monopoly. Thus there is some faint hope that broadcasting in general, and television in particular, may after all be rescued from the party-political arena into which it has now fallen.

For this small ray of hope we must be thankful; there is little other cause for satisfaction in the Government's proposals. The policy laid down in the White Paper, with its complicated system of programme companies buying time from a public corporation owning and operating the new stations, is not likely to lead to the healthy growth and rapid development of television. The system is a compromise that will not satisfy the advocates of full-blooded commercial competition; at the same time, it will fail to appease those who believe in public-service broadcasting. Neither does the proposed scheme seem to please the great majority of those concerned with radio as a livelihood.

Wireless World is not concerned with the political ideologies that go with either commercial competition or the principle of public service, but we want to see a rapid and orderly growth of television. The great fault of the Government scheme is that it is certain to be slow in developing. No detailed plans have yet been made and, even when they are decided upon, a prolonged legislative process (no doubt contested at every stage) will be needed before the scheme can be put into effect.

Even if planning and legislative processes can be speeded up, there remains the difficulty of finding channels for a useful number of the new competitive stations, which are to operate in Band 3 (174-216 Mc/s). At present only two channels are available in this band; the other six are occupied by other services. Although it is the avowed intention of the Government to clear the band in its entirety for television, this will take time; a period of seven years has been mentioned. The "squatters" at present occupying Band 3 have not yet, so far as we know, been given notice to quit.

To be a success, competitive television should from the very start be launched on a fairly big scale. A commercial system as proposed, with two or even three low-powered stations, is unlikely to attract good (and consequently expensive) programmes. As a natural result, the growth of the viewing audience will be slow.

Then there is the question of receivers, the manufacturers of which would have many embarrassing problems to face. The production of two-band sets in limited numbers for restricted areas of the country would clearly be uneconomic, and so prices would be high. Demand in turn would be limited, and so the elements of a vicious circle arise. From the point of view of the receiver manufacturer, and of the public as well, everything is in favour of starting a service on a new band, whether competitive or alternative, on the largest possible scale. Rather than wait for Band 3 to be cleared, it would probably be better, and quicker in the long run, to adopt the suggestion made in our September, 1953, issue, and by-pass Band 3 altogether in favour of Band 4 (470-585 Mc/s). Incidentally, the "mobile radio" industry is likely to find itself in an unenviable position unless something of this sort is done.

Finally, the cost of a competitive service on the lines of the White Paper seems to call for a heavy expenditure of national resources. We have already expressed the hope that an alternative scheme may yet be found. The Government's objection to the B.B.C. monopoly is that it is a monopoly in the distribution of ideas: would it not meet this objection more economically for the Corporation to continue the technical distribution of all television, but for the control of alternative programmes to be delegated to a suitably chosen independent body?

* Cmd. 9005; H.M.S.O., 4d.

Experimental Transistor

AN interesting method of gaining practical experience of the circuitry employed with transistors is to use them experimentally in radio receivers. Sets using them have a value, quite apart from their novelty or academic interest, because of their extremely low power consumption, and two possible circuit arrangements are described below giving useful performance with a total current consumption of 6.0 mA at 18 V.

Some elementary consideration of these circuits and the steps leading up to them may be of interest and help to experimenters when they have an opportunity to try transistors for themselves.

At a stage when transistors tend to be scarce and relatively expensive it seems appropriate to achieve the highest possible gain from the smallest number of transistors, even at the expense of making the circuit and its adjustment a little less simple. This consideration suggests reaction and reflexing, both common aids to sensitivity in the earlier days of thermionic valves. At first it seems somewhat doubtful whether a transistor with a collector dissipation limit of 100 mW could possibly give sufficient output for loudspeaker operation, but it was found that the volume obtainable with an input of about 20 mW into a sensitive instrument was surprisingly acceptable and perfectly adequate for following all types of programme. Some deliberate restriction of bass response by preventing overloading of the output transistor with frequencies making no audible contribution at this low power was helpful in this respect. It is also fortunate that quite a high degree of harmonic distortion sounds relatively innocuous at low output levels. Incidentally, to clear up what seems to be a very common misapprehension, it might be mentioned that at the present moment no junction transistors on the market anywhere appear to have collector dissipations exceeding 150 mW and many are limited to 50 mW. Junction transistors with higher dissipation are as yet in the laboratory stage.

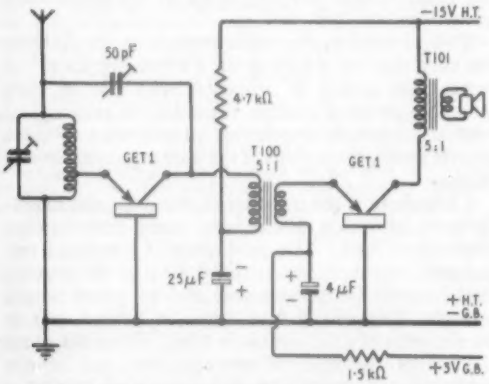


Fig. 1. Simple two-stage transistor receiver with reaction.

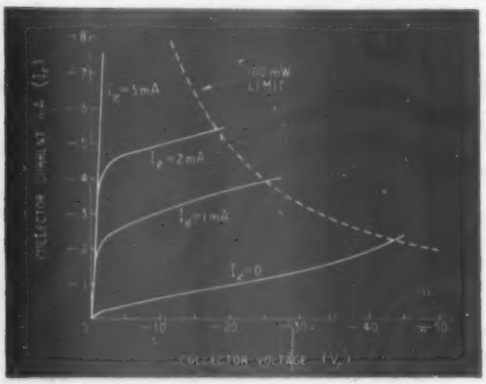


Fig. 2. Static characteristics of type GET1 point-contact transistor.

The simpler of the two circuits is shown in Fig. 1 and consists of one transistor acting as detector with reaction, transformer coupled to another transistor feeding the loudspeaker. The output stage will be considered first. Examination of the characteristics of a typical transistor, Fig. 2, shows that a conservative working point is with collector volts 15 and collector current 5 mA, and that a suitable load line is given by 4,000 ohms. A listening test, using a variable-ratio output transformer, confirmed that this value was suitable and by no means critical, so that slight variations from one transistor to another would be accommodated.

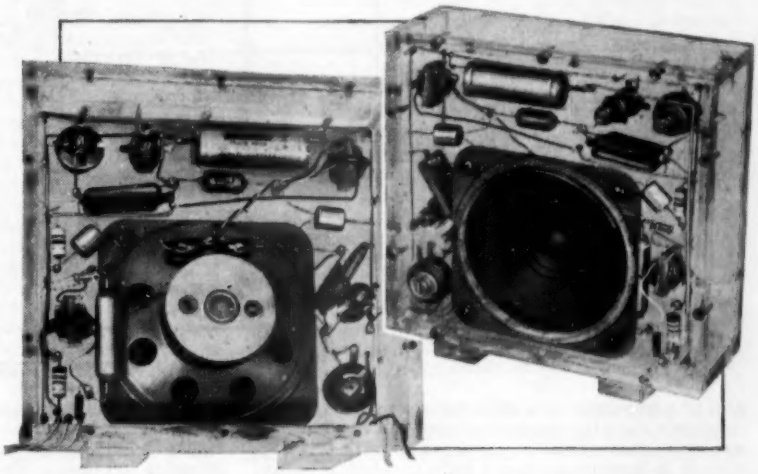
This empirical test of working conditions is easily carried out by feeding in a low-level audio signal from a broadcast receiver and in the absence of more elaborate equipment it seems well worth while to establish satisfactory operation in this way. It is suggested that the 5:1 coupling transformer (Multitone Type 100) shown in Fig. 1 should be used for this purpose, its primary being fed through a capacitor from a suitable point such as the anode of the first a.f. valve. The feeding in of high level signals or surges must be avoided. To obtain the correct working point the transistor requires an emitter bias current of 2 mA approx. which is obtained from a 3-volt supply through a suitable resistance. Part of the bass cut is achieved by using a small value of capacitance to decouple this. If all the required bass cut had already been obtained elsewhere, say in the coupling transformer, any convenient value of voltage and resistance which would give the correct current would be permissible. It is, of course, necessary when dealing with transistors always to think of bias in terms of current.

Resistance in the base circuit of a transistor will provide automatic bias and so avoid the necessity for a separate battery tap, but its use is not recommended. Whilst in the case of a thermionic valve automatic bias tends to compensate for characteristic changes and power supply fluctuations, with a transistor this type of circuit exaggerates the effects of such variations, and in some cases may produce trigger effects or relaxation oscillations. This is because there is no phase reversal between emitter and collector and

Receiver

Simple Circuit for Local Station Reception

By
B. R. BETTRIDGE,*
A.M.Brit.I.R.E.



With a 3½-in loudspeaker a very compact receiver can be built using two transistors.

the resistance in the base therefore gives positive feedback, the d.c. component of which remains even after the a.f. is shunted by a large capacitor. The attractive possibility of increasing a.f. gain by a deliberately unbypassed base resistor does not appear to be realizable in practice because of difficulty with stability, but further exploration might be rewarding.

Undoubtedly in some areas this output stage could be fed from a simple crystal diode detector but in the author's locality this is not possible. Rather than use a second a.f. stage it was thought better to use a further transistor as detector, bearing in mind that this would enable reaction to be obtained.

A transistor with no emitter bias acts as a detector, since only positive excursions of the emitter influence the collector current. It is necessary, therefore, only to couple a tuned circuit to the emitter and to feed the resulting a.f. signal in the collector circuit to the next stage. There is no particular difficulty about this, but a somewhat different approach is required from that appropriate to valves.

Although we are used to valves with their high input impedance we ought not to be disturbed when we hear that a transistor has a value of about 200 ohms for this parameter, except perhaps to the extent of wishing it were lower still. The thermionic valve is a voltage-operated device and hence its high input impedance means that very little power is required to drive its grid. The transistor, on the other hand, is a current-operated device and thus, in order to operate with minimum power, it is desirable for its input impedance to be as low as possible. If the input impedance of a transistor were low enough the emitter could be connected in series with the elements of the tuned circuit so that all the circulating current would be available for driving it. With values met with in practice we cannot do this, and we arrange for a suitable proportion of the current to flow through the transistor to get the best compromise between efficiency and damping.

One obvious way of doing this, and quite an effective one, is to tap the inductor and this is the method used in Fig. 1. It will be found that a satisfactory tapping point is one-fifth from the earthy end. This tapping down does not sacrifice gain, as it would do in the case of a valve, because it increases the current driving the emitter and it must be remembered that couplings which give current step-up instead of voltage step-up are appropriate to transistor circuitry. Similarly the coupling between the collector of the detector and the output transistor is by a transformer having a turns step-down ratio of 5:1 which is better regarded in this connection as having a current step-up ratio of 1:5. The precise value of this ratio was not found to be critical, and variations between limits of one to three and one to seven made little audible difference.

The h.t. supply to the collector needs to be only about 10 volts for sufficient output to drive the next stage fully, so this enables decoupling to be incorporated. The introduction of reaction to improve gain and selectivity is delightfully easy and the trimmer between collector and tuned circuit is all that is required in view of the lack of phase reversal previously mentioned. This set is sensitive enough to operate at its full volume about 20 miles from a regional transmitter using a small outdoor aerial.

Frequency Limitations

A few remarks on transistor characteristics should be interposed here. Those at present available in this country have a nominal minimum cut-off frequency of about 250 kc/s (this is defined as the frequency at which the current gain has fallen by 3 db). Many operate up to 1 Mc/s, whilst some function at considerably higher frequencies. However, bearing in mind this possible limitation, experiments with reaction could well be tried first of all on the long-wave Light Programme rather than the medium-wave local station. Another point is that the current

* General Electric Company (Osram Valve and Electronics Dept.).

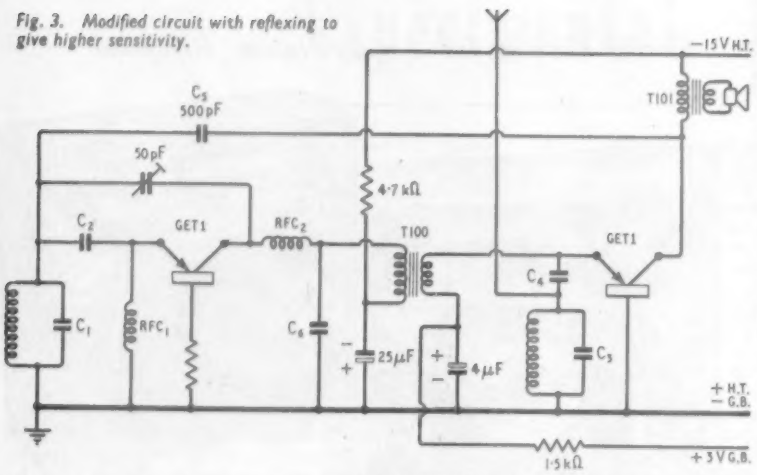


Fig. 3. Modified circuit with reflexing to give higher sensitivity.

gain of a transistor does not reach a satisfactorily high value, nor does its input impedance fall to a satisfactory low value until a certain amount of emitter current is flowing, so that a little standing bias may be helpful in bringing the detector to its most sensitive point, and to a point, incidentally, where reaction effects are more readily obtained. A small amount of resistance in the base circuit will effect this, and a variable resistor of about 500 ohms should be used initially to determine the best value. The objections to auto bias mentioned previously hardly apply to this case, since the amount required is so small. Due to the resistance of the germanium crystal itself there is always unavoidable base resistance built into a transistor. This tends to vary somewhat from one specimen to another, hence the need to experiment with the amount to be added externally. It will be found that none at all is needed in some cases.

A more complicated circuit, based on the previous one, is shown in Fig. 3. This gives improved selectivity and higher sensitivity so that a "picture rail" aerial is adequate in the majority of cases. The two main points of difference are the avoidance of tapped inductors for matching, and the achievement of higher sensitivity by means of a reflex circuit. The method adopted to cover the first point has been described elsewhere[1] and consists of splitting the tuning capacitance into two parts, one being directly across the inductor and the other across the inductor in series with the emitter of the transistor, as illustrated by C_1 and C_2 in Fig. 3. By altering the relative sizes of the two capacitors any proportion of the circulating current can be caused to flow in the emitter circuit, which gives in effect an infinitely variable tap, and constitutes an extremely convenient circuit. A d.c. path for the emitter current must be provided and in the case of an amplifier this can consist of a resistor. With a detector, however, a rectified component would be developed across the resistance of such polarity as to cancel partially the a.f. signal already produced in the collector circuit, and in this case a radio-frequency choke must be used.

In the practical case of the aerial circuit in Fig. 3 an inductor requiring about 900 pF to tune it worked satisfactorily with 750 pF directly across it and the remaining 150 pF in series with the emitter. A low L/C ratio circuit was chosen deliberately and amongst other advantages allows the aerial to be connected directly to its live end, and eliminates the need for a further tap or coupling coil.

The reflex arrangement may require explanation to those not familiar with this type of circuit. The output transistor is required to amplify first at r.f. and then at a.f., and the aerial circuit is therefore coupled into its emitter by the split capacitor technique mentioned above. The presence of the secondary of the a.f. transformer is no embarrassment, and it provides the d.c. path for the necessary bias. Its r.f. impedance does not have to be particularly high, since that of the circuit at this point is about 200 ohms. The amplifier r.f. signal appears in the collector circuit and is developed across the primary of the output transformer, whence it is fed to the detector circuit via C_5. By using a low L/C ratio circuit here, damping due to doubtful r.f. properties of the output transformer primary is not serious. An r.f. choke could be included between collector and transformer to place this matter beyond doubt, but was never found to give any advantage with any components actually tried.

The matching to the detector emitter is effected by appropriate choice of C_1 and C_2 and RFC_1 provides the d.c. path for emitter current. The signal then reaches the output transistor for the second time *via* transformer T100, but only its a.f. component, the r.f. component being filtered by RFC_2 and C_6 to prevent any chance of it being fed back to the aerial circuit and causing instability.

Incidentally, omission of the tuned aerial circuit and connection of the aerial direct to the emitter of the output transistor gives a circuit arrangement the performance of which is midway between those shown in Fig. 1 and Fig. 3 and may be found worth while in certain cases.

Reflex arrangements are notoriously "temperamental," but the only trouble experienced when developing this circuit was a distressing form of overload due to an oscillation being momentarily triggered by loud signals. This was cured by the incorporation of the filter, RFC_2 and C_6, previously referred to in the detector collector circuit. Occasional overload on peaks, which is almost certain to occur when output power is so limited, is singularly free from unpleasantness, and the set seems superior in this respect to many receivers using in their output stages small battery pentodes which cannot be said to overload gracefully.

Anyone wishing to follow the author in these experiments should take special note of the following remarks, since transistors are still expensive and easily damaged.

A meter must be used in the collector circuit to guard against over-dissipation, and one in the emitter circuit is very desirable whilst setting up.

[1] "Transistorizing Communication Equipment," by G. S. Epstein, J. A. Bush and B. Shellhorn, *Electronics*, May, 1952, p. 98.

Resistors in emitter or collector circuits to act as limiters are a reasonable safety precaution in the initial stages, but their presence can upset circuit operation.

In the final circuit the detector has a collector limiter in the form of a decoupling resistance, whilst the amplifier, although it has no resistance in its collector circuit except the resistance of the output transformer, has the bias resistor in its emitter circuit.

An h.t. line negative with respect to earth takes some time to get used to, but accidental reversal of polarity can in some cases ruin a transistor and special precautions should be taken to prevent such an accident.

It should be realized that quite a small capacitor can store sufficient energy to fuse the point of a transistor whisker if it is given the opportunity.

A little common sense will be a safe guide, taking into account that emitter and collector can be regarded separately as diodes, and a diode will pass very large current when its whisker is made more than about one volt positive; but current is limited to quite a small value when the whisker is made negative provided that this value does not exceed 20 volts or so.

A concealed danger exists in the negative resistance characteristic resulting from a base resistance, since this can cause a trigger effect with very high currents flowing.

More h.t. voltage than necessary should not be used. Point contact transistors work efficiently from an h.t. supply of 15 volts, so that two 9-volt grid bias batteries in series will supply this in addition to the 3 volts required for the current bias.

Since this receiver is experimental no detailed constructional information will be given, but a few notes about components may be helpful. Because the receiver itself can be made very small, it seems logical to use the smallest loudspeaker available. It has to be remembered, however, that considerable sacrifice of sensitivity results from decreased speaker size, so that some compromise seems desirable. The set shown in the photographs uses a 3½ in speaker and the volume is sufficient for a quiet room. Substitution of a really sensitive speaker such as the Goodman Axiom 102 enables programmes to be followed against considerable ambient noise.

It will be noted that the set in the photograph uses a very convenient technique which has been recently described.[2] This makes use of the fact that a wire or bolt held in pliers and heated with a soldering iron can be pushed straight into Perspex sheet and is anchored firmly on cooling. This is very much quicker than drilling a chassis and using anchoring tabs, and it enables a breadboard layout to be used with modern components.

No form of volume control comparable to that using variable-mu valves can be employed, but a variable resistance in the aerial is quite effective. The circuits shown are not suitable for variable tuning and if more than one station is required separate tuned circuits should be switched.

The coils used were made by Weymouth Radio Mfg. Company.

[2] "Fabricating Circuits on Plastic Breadboards," by J. H. Bigbee, *Electronics*, Sept., 1952, p. 126.

BOOKS RECEIVED

Thermionic Valves, by A. H. W. Beck, B.Sc.(Eng.), A.M.I.E.E. Theoretical account of the physical principles of thermionic vacuum devices with emphasis on micro-wave valves and a chapter on picture converters and storage tubes. Pp. 570+XVI, Figs. 210. Price 60s. Cambridge University Press, 200, Euston Road, London, N.W.1.

Nuclear Physics, by W. Heisenberg. Translation from the German of a series of lectures on the history, state of contemporary knowledge and practical applications (up to 1948). An appendix gives an account of activities in Germany during the war. Pp. 225; Figs. 40. Price 12s 6d. Methuen and Company, 36, Essex Street, London, W.C.2.

Radio Engineering, Vol. I, by E. K. Sandeman, Ph.D., B.Sc., A.C.G.I., M.I.E.E. Second edition revised and extended to include transmission line filters, and some further information on the calculation of noise factor in receivers. Pp. 779; Figs. 275. Price 60s. Chapman and Hall, 37, Essex Street, London, W.C.2.

Relays, by R. C. Walker, B.Sc., A.M.I.Mech.E., A.M.I.E.E. Reference book on the principal features and potentialities of relays as switching devices for electronic and industrial control. Pp. 303; Figs. 187. Price 42s. Chapman and Hall, 37, Essex Street, London, W.C.2.

Microwave Lenses, by J. Brown, M.A. Monograph on the underlying principles and mathematical relationships in the design of aerial systems for the 1 to 50-cm range, including "artificial dielectrics." Pp. 125; Figs. 57. Price 8s 6d. Methuen and Company, 36, Essex Street, London, W.C.2.

The Practical Electrician's Pocket Book, 1954. Edited by Roy C. Norris. Comprehensive manual of electrical installation work. Pp. 552 with numerous figures and tables. Price 5s. Odhams Press, 6, Catherine Street, London, W.C.2.

The Home Constructor. Booklet of circuits and wiring plans for building crystal sets, t.r.f. and superhet receivers, feeder units and a 10-watt amplifier. Pp. 40, illustrated. Price 2s 6d. Supacoils, 21, Markhouse Road, London, E.17.

Data and Circuits of Television Receiving Valves, by J. Jager. Book IIIC of the Philips series of books on electronic valves, giving complete characteristics of relevant Philips valves and typical associated circuits. Pp. 216+X1; Figs. 226. Price 21s. Cleaver Hume Press, 31, Wrights Lane, Kensington, London, W.8.

Television Receiver Design Monograph, by P. A. Neeteson. An analysis of saw-toothed generators, flywheel synchronization and automatic phase control. Pp. 170; Figs. 120. Price 21s. Cleaver Hume Press, 42a, South Audley Street, London, W.1.

La Télévision en Couleurs, by L. Chrétien. Review of principles and description of alternative systems. Pp. 92; Figs. 56. Price 360 Fr. Editions Chirons, 40 Rue de Seine, Paris 6.

Les Cahiers de l'Agent Technique Radio III, by P. Hemardinquer, R. Asmen, J. Lignon and G. Giniaux. Characteristics, methods of testing and calculations relating to resistors, potentiometers and capacitors. Pp. 64; Figs. 78. Price 405 Fr. Editions Chirons, 40 Rue de Seine, Paris 6.

Stereophony in the Cinema

Recent Developments Using Multiple Magnetic Sound Tracks

By J. MOIR,* M.I.E.E.

TALKING films had their commercial introduction in 1927, the sound being recorded either on 17-in diameter wax discs rotating at 33 r.p.m., or photographically on a 84-mil (0.084in) wide track to one side of the picture space, and inside the sprocket holes. At the time of introduction there is little doubt that the "sound on disc" systems gave better sound quality, mainly due to the considerable background of experience previously obtained in producing ordinary gramophone records. This advantage was insufficient to offset the practical disadvantages of having sound and picture on different carriers, and by 1930 the photographically recorded sound track was almost universal, and has remained so until recent months. Photographic tracks are capable of a high standard of performance when the processing and printing conditions are carefully controlled, but this care does not always extend down to the copies that reach the local cinema, with results that are only too obvious to the patron.

The deficiencies of photographic tracks are not the subject of the present discussion, but it can be said that the frequency range, signal/noise ratio and amplitude distortion do not measure up to the standards achieved in v.h.f. broadcasting or magnetic recording. In spite of this adverse comment there is little doubt that further improvement in sound quality beyond the standard achieved in the better theatres would not in itself attract a larger audience. However, in the normal course of development, hastened perhaps by the competition of television, it has been decided that there is a public demand for larger pictures, and as this has necessitated some change in the sound equipment the opportunity of introducing magnetically recorded stereophonic sound has been taken.

But first of all a brief comment on the picture size. Until recent months a picture having an aspect ratio (width/height) of 4:3 has been the standard with a picture size around 24ft × 18ft, but about the beginning of this year the industry began to move towards larger screens having an area around 1,000 sq ft, and almost any aspect ratio between 1.5:1 and 2.6:1. This was achieved not by making any change in the film standards, but by using a shorter-focus projection lens to give a larger 4:3 picture on the screen and then masking this down at top and bottom to achieve the desired aspect ratio. Unless the mask size was reviewed for each new film, this change had the ludicrous effect of chopping off heads and feet that strayed towards top or bottom of the screen, but in spite of this there has been a marked swing towards the use of these "panoramic" screens.

It became inevitable that the major film-producing organizations would introduce a properly engineered

* British Thomson-Houston Company (Electronics Engineering Dept.).

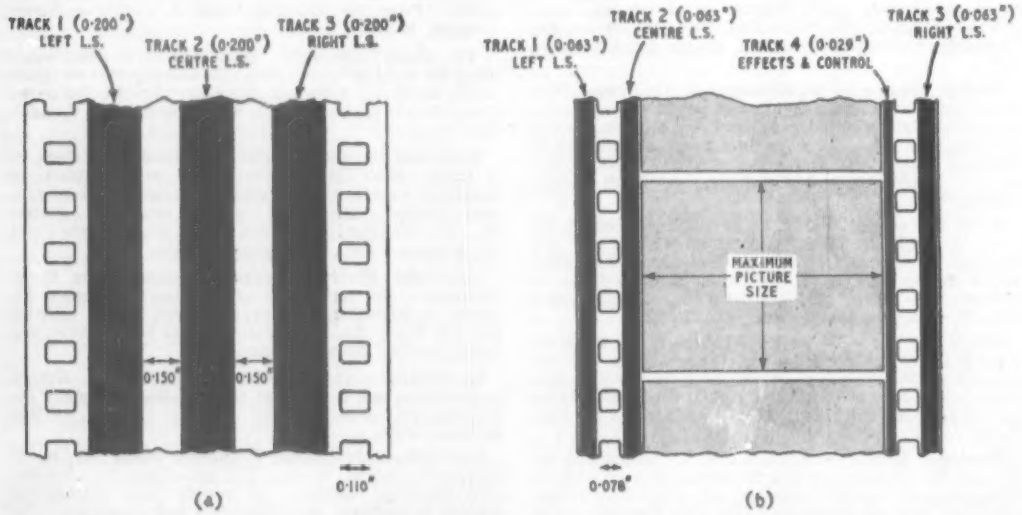


Fig. 1. Details of magnetic coatings on 35-mm film, (a) using separate film for the sound, and (b) in "CinemaScope" system with sound and picture on the same film.

wide screen, and the first of these, the 20th Century Fox "CinemaScope," has been recently introduced to London audiences for the showing of "The Robe" at the Odeon Theatre, Leicester Square. The screen used for the showing of this film has an aspect ratio of 2.55 : 1 and an area of nearly 1,000 sq ft.

Wide screens have their own particular problem for the sound system designer, for it would be ridiculous to have the visual image over on one side of a screen 50ft wide while the sound was obviously produced by a speaker system somewhere about the centre of the screen. This problem can be solved by the introduction of a stereophonic sound system requiring three sets of loudspeakers behind the screen, three amplifiers, three sound tracks, and on the recording stage three microphones and recorders.

The fundamentals of stereophonic sound systems have been dealt with in an earlier article[1] and need not be repeated, but it is worth remembering that the use of a three-channel stereophonic system enables the positions of the sound image and visual image to be brought into coincidence at any point on the screen width. A true stereophonic system enormously heightens the dramatic impact of the sound upon the audience for both speech and music.

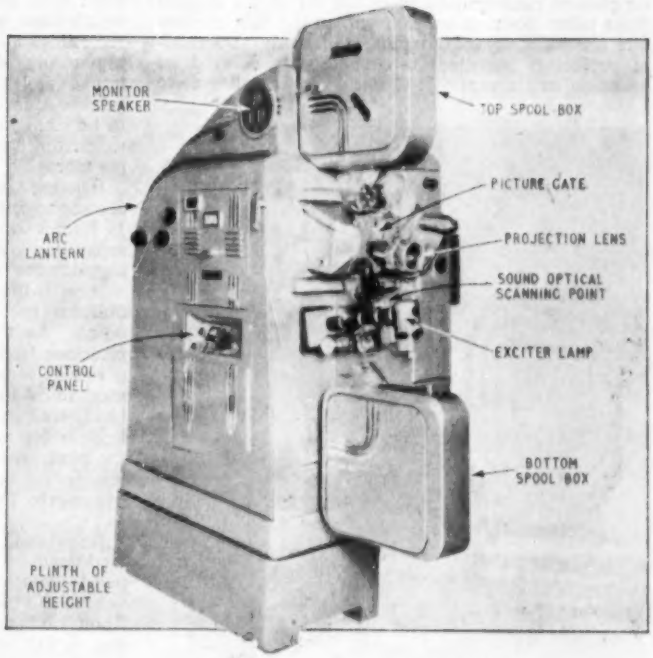


Fig. 2. Modern projector showing normal sound-scanning optical system below the picture projector.

The first full-length stereophonic film to be released was Walt Disney's "Fantasia," a film having the standard aspect ratio with stereo sound photographically recorded on four tracks on a separate sound film. The disadvantages of photographic recording were overcome to some extent by recording the three signal tracks at substantially full amplitude, using the fourth track to carry signals to control the gain of the main amplifiers.[2]

A true stereo system provides accurate location of the sound image across the width of the screen and in depth behind the screen, but there are situations where "effect noises" might be expected to have their origin to either side of or behind the audience. For this purpose it has become the practice to mount small loudspeakers on the rear and side walls of the auditorium, the operating signal being carried by a fourth sound track.

The recording engineer therefore has the problem of finding space on the film for four separate sound tracks, and as for other reasons the space devoted to the picture cannot be reduced the problem is one of considerable difficulty. No universally acceptable solution has yet appeared but two suggestions seem to be finding favour. In the first, Fig. 1 (a), as used by Warners for such films as "House of Wax," a separate 35-mm film is provided for the three stereophonic signals, magnetic recording on 200-mil wide tracks being employed. A separate sound reproducer machine is employed to run this film, the picture projector and sound reproducer being locked and synchronized by a Selsyn link. The sound signal for the auditorium speakers is carried by a standard type of photographic track on the picture film.

An alternative solution, favoured by 20th Century Fox, is illustrated in Fig. 1 (b). Three 63-mil wide tracks and one 29-mil magnetic track are located on the picture film in the space on either side of the sprocket holes which have been reduced in width from 0.110in to 0.078in. Films to this standard have been used for such films as "The Robe" and "How to Marry a Millionaire."

Both proposals merit careful consideration. The separate sound film has the potential advantage of providing better sound quality, but the disadvantage of requiring a second machine and an interlocking system, a disadvantage that is overcome when sound and picture are on one film. However, it cannot be denied that in the single film system the sound tracks located outside the sprocket holes are particularly vulnerable to damage in handling. Location of tracks in this position and the use of narrow sprocket holes are bold steps to take, and require the justification of experience.

A point of more immediate interest is that photographic recording has been abandoned in favour of magnetic recording in order that current standards of film sound quality should not only be maintained but improved upon, in spite of the small amount of space available for the tracks.

Magnetic sound recording has already virtually

[1] *Wireless World*, March, 1951, p. 84.
[2] *Wireless World*, Nov., 1941, p. 276.

supplanted photographic recording for all the original shots taken both on location and in the film studios, but the difficulty of adapting the many thousands of projectors installed in cinemas has delayed its adoption in cinemas. It is fairly obvious that there must be a transition period of several years during which films will be available with either method of recording, and the same projector will have to deal impartially with either magnetic or photographic tracks as the week's programme demands. To achieve this the magnetic reproducer head has had to be designed as an extra unit that could be added to existing picture projectors without disturbing the photographic track reproducer.

Existing industry standards require the sound accompanying a particular picture action to be located 19 frames ahead of that picture, this order of spatial separation being required for the mechanical filtering devices necessary to convert the intermittent motion of the film in the picture gate to the perfectly uniform motion necessary at the sound scanning point. As the film travels downward through the projector from a spool box above the mechanism to a similar storage magazine below the projector, the mechanical filters and optical scanning system (sound head) are located *below* the point at which the picture light beam passes through the film, as indicated in the photograph of a modern picture projector Fig. 2.

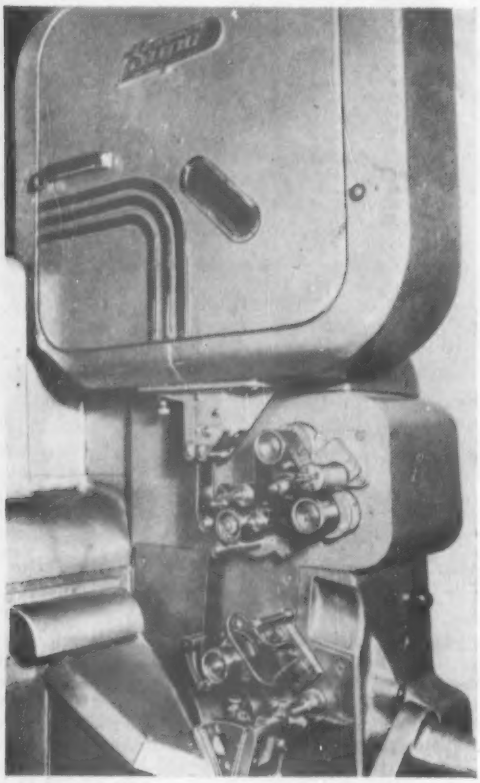


Fig. 3. Experimental "bolt-on" unit mounted above the picture projector for scanning multiple magnetic tracks.

Magnetic Pickup Head

Installation of a further sound reproducer head is facilitated by placing it *above* the picture gate at a point tentatively standardized at 28 picture frames behind the picture frame being projected. A typical "bolt on" magnetic reproducer head is shown in Fig. 3, the simplest form of head being installed by merely unbolting the top spool box and mounting the magnetic reproducer head in its place, the spool box being replaced on top of the reproducer head.

The magnetic reproducer head has not the same simplicity as the "tape decks" available to the public for use with 0.25-inch tape running at 7.5 inches per second, the added complexity resulting from the rather elaborate mechanical filters necessary to achieve uniform motion of the film at the sound scanning point. The film is moved intermittently through the picture gate during projection, light only passing through the film while it is stationary, the stationary period being followed by a very rapid "pull down" to the next picture frame while the light is cut off by a rotating "flicker" shutter. If tolerable values

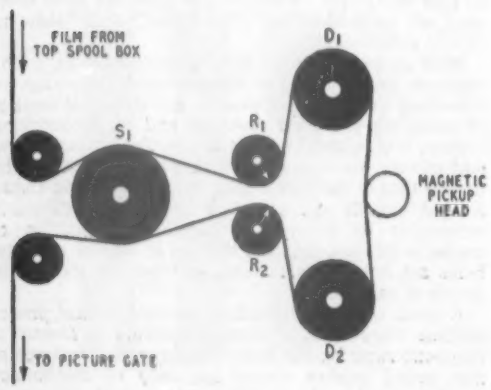


Fig. 4. Diagrammatic arrangement of mechanical filter for magnetic head.

Fig. 5. Four separate pickups are accurately spaced and aligned in the magnetic head.

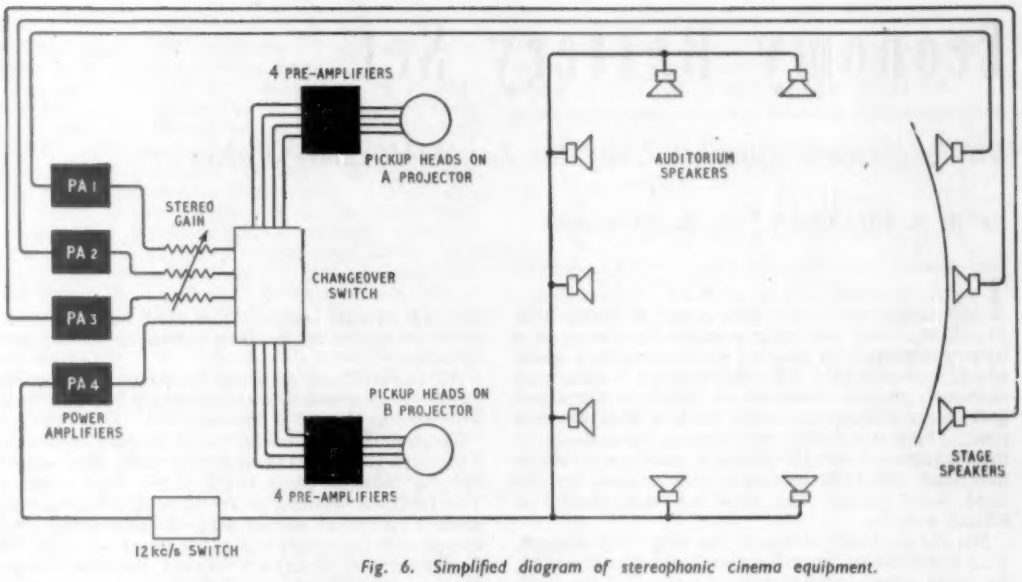


Fig. 6. Simplified diagram of stereophonic cinema equipment.

of "wow" and "flutter" are to be achieved this intermittent motion of the film must be completely smoothed out at the sound scanning point.

Elimination of all intermittent film motion is achieved by passing the film through the filter assembly shown in Figs. 3 and 4. Film from the top spool box passes over a sprocket S_1, over the first of a pair of light guide rollers R_1 spring-biased in the downward direction and then over a drum D_1 having a fairly heavy flywheel on its shaft and on to the picture gate by way of a second drum D_2 and light spring-biased guide roller R_2. Disturbances in the film motion orignating in the picture gate or top spool box are taken up by the movement of the light pivoted guide rollers R_1 and R_2, movement of the film over the actual magnetic pickups being stabilized by the flywheels on the drum shafts. The r.m.s. sum of all the "wow" and "flutter" components is less than 0.1 per cent.

The magnetic pickup group (Fig. 5) is an assembly of four separate toroids, jig assembled to ensure that none of the four scanning gaps deviates from the mean position by more than 0.0002in or has an angular misalignment greater than 10 minutes of arc. Maintenance of this high order of accuracy permits the head group to be adjusted in azimuth as a single unit.

The block schematic of Fig. 6 indicates the system circuit layout. Signals from the magnetic pickup heads on each machine are amplified by a group of four pre-amplifiers, which raise the signal level sufficiently to ensure a "clickless" changeover by the machine selector relay R_1 operated by a push-button on either machine. The same push-button simultaneously opens the light shutter on the incoming machine and closes the light shutter on the outgoing machine. The four signal outputs from the pre-amplifiers are further amplified by the power amplifiers PA1-4 to drive the three sets of stage loudspeakers behind the screen.

The output of the "effects track" power amplifier is used to drive a group of high-quality loudspeakers mounted on the rear and side walls in the auditorium. The "effects track" has a scanned width of only 25 mils, hardly sufficient to give adequate signal/noise ratio, a difficulty that is increased by the nearness of the actual speakers to the audience. Stray noise during silent periods is eliminated by an automatic switch which opens the speaker circuit, except during the time when "effects noises" are to be reproduced. This switch is actuated by the appearance of a 12-kc/s tone on the "effects track," the tone being recorded at a level 18 db below maximum modulation depth. The tone is separated from the "effects" noise spectrum by a two-stage filter, amplified, rectified and applied to a small relay having its contacts in the auditorium speaker circuit, the 12-kc/s tone being eliminated from the speaker circuit by an appropriate low-pass filter.

Sound film reproducing equipment has been getting more and more complicated with each successive design, a trend that is paralleled in almost every other field of engineering, but the introduction of stereophonic sound and auditorium speaker effects has resulted in a sharp increase in complexity, the amount of equipment required being almost four times that required for a straightforward monaural system. Justification for this complication must be in the results obtained, but the public's opinion is awaited with considerable confidence.

"TECHNICAL TRAINING"

TWO of the colleges listed in our note on Technical Training in the November issue have advised us of additional facilities provided by them. Bradford Technical College's curriculum includes, in addition to the courses quoted, Higher National Certificate courses with telecommunications and B.Sc. degree courses with electronics or telecommunications. Walsall Technical College also includes electronics in its H.N.C. course in electrical engineering.

Economy Battery Set

Straightforward Superhet Using the Latest Miniature Valves

By R. S. CHANNON,* B.Sc.(Eng.), Grad.I.E.E.

THE introduction of a new range of valves with 25-mA filaments has made possible the design of a battery receiver with very low l.t. consumption—actually 125 mA at 1.4 V. The circuit, which is quite conventional, gives a sensitivity of 100 μV at the signal grid of the frequency changer for 50 mW at the output. Three wavebands are covered—long waves in the frequency band 150-360 kc/s, medium waves in the band 530-1,530 kc/s and short waves in the band 6-18.7 Mc/s. The total h.t. consumption is 9.8 mA at 90 V.

For the oscillator section of the frequency changer, V_1, a conventional series-fed tuned-grid circuit is used. By using tightly-coupled coils of high Q it has been found possible to keep the variation of grid current within the recommended limits of 90 μA to 150 μA on both the long- and the medium-wave bands. On the short-wave band, however, the variation of grid current with the normal circuit arrangement is considerably greater (approximately 85 to 200 μA), and to avoid the consequent extensive changes in conversion conductance a booster circuit is used. This consists of a coil and a fixed capacitor of 68 pF, the combination resonating at approximately 4.8 Mc/s. This has the effect of increasing the drive at the lower frequency end of the waveband, thus permitting the coupling between the oscillator coils to be reduced. In this design a separate booster coil is used, but if necessary it can be wound on the same former as the oscillator windings.

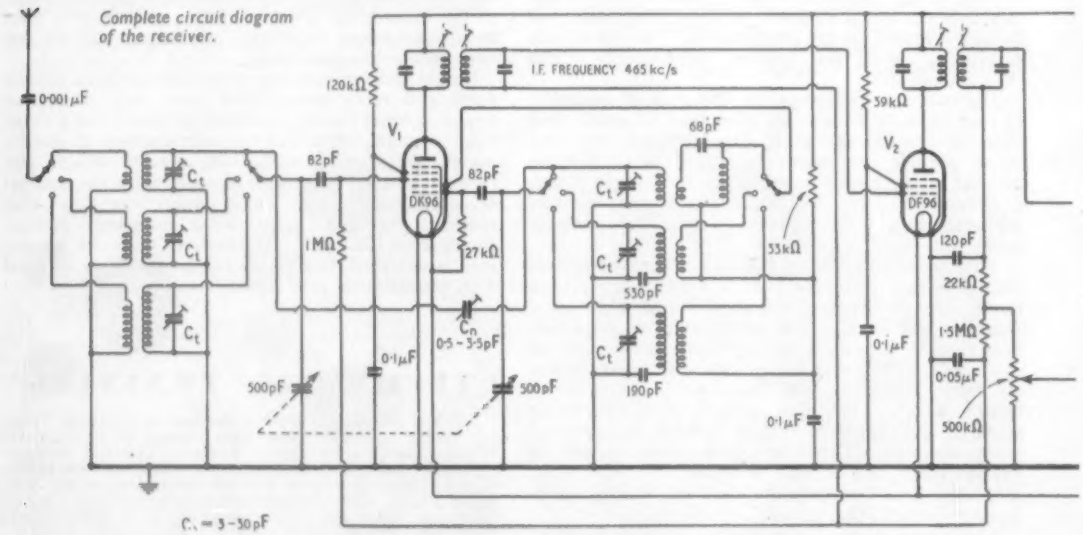
All the oscillator coils are wound on $\frac{1}{2}$in diameter Paxolin former and fitted with Neosid 900 dust cores. The winding data is as follows.

Short-wave Coils.—The tuned winding consists of 9 turns of 18 s.w.g. tinned copper wire, open wound. Spacing between turns is 0.7 of the wire diameter. The feedback winding is $7\frac{1}{4}$ turns of 38 s.w.g. silk-covered enamelled copper wire, $4\frac{1}{4}$ turns being interwound with the earthy end of the tuned winding. For the booster coil, 40 turns of 36 s.w.g. enamelled copper wire are wave wound on a 6.5-mm former over a length of 3 mm.

Medium-wave Coils.—Here the tuned winding consists of 55 turns of 38 s.w.g silk-covered enamelled copper wire, wave wound over a length of 4.5 mm. For the feedback winding, 15 turns of 42 s.w.g. enamelled copper wire are close wound in a single layer on top of the tuned winding. The two windings are separated by a double layer of thin insulating paper.

Long-wave Coils.—For the tuned winding, 140 turns of 38 s.w.g. silk-covered enamelled copper wire are wave wound over a length of 5 mm. The feedback winding is 22 turns of 42 s.w.g. enamelled copper wire, close wound in one layer on top of the tuned

* Mullard, Ltd.



winding. Again the windings are separated by a double layer of thin insulating paper.

The aerial coils and i.f. transformers are all standard types. It is essential to use a good wave-change switch and care should be taken with the wiring around it. As for the aerial itself, a frame aerial is adequate for medium and long waves, but an outdoor aerial is recommended for short waves.

To avoid excessive pulling of the oscillator whilst trimming the aerial circuit, a variable neutralizing capacitor, C_n (0.5-3.5 pF Polar Type S50.01/1) is connected between the signal grid and oscillator grid. This should be adjusted until the oscillator voltage on the signal grid is a minimum. As the required neutralizing capacitance (approximately 2 pF) varies only slightly with the frequency, it is possible to neutralize at the upper trimming point, which for this receiver is 16.9 Mc/s, without adversely affecting the short-wave performance at 18.5 Mc/s. It is, of course, possible to use a fixed neutralizing capacitor, but the tolerances on these small capacitors are large, and there is a risk that if the capacitance is at the limit of the tolerance the peak pulling may increase from 10 kc/s to at least 35 kc/s, and this is liable to make trimming difficult.

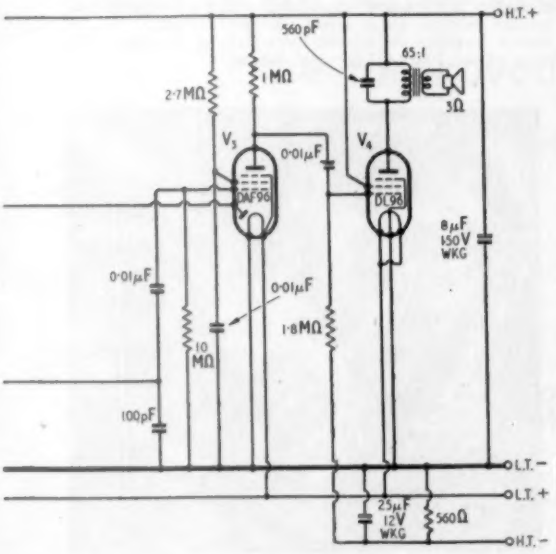
If a booster coil is not used, and the grid current is allowed to rise to 200 μA at the high-frequency end of the band, the peak pulling is reduced to 4 kc/s. However, the drift with a.g.c. bias is then greater and is sufficiently large to affect the tuning of the receiver, and in these circumstances it may be necessary to modify the switching so that the a.g.c. bias is not applied to V_1 on the short-wave band.

While the high-frequency effects improve with decreasing frequency, and are normally negligible below 10-12 Mc/s, it is necessary to earth the casing of the tuning capacitor between the two sections; otherwise the oscillator voltage on the signal grid is liable to increase from something less than 100 mV to approximately 250 mV at the low-frequency end of the short-wave band.

The operating voltages and currents of the four valves under normal conditions are given in the table below. In V_1 the accelerator grid g_3 should be at a voltage of 72 V and draw a current of 0.11 mA.

Valve	V_a	V_{g2}	I_a(mA)	I_{g2}(mA)	I_k(mA)
V_1	85	32	0.4	1.6	2.11
V_2	85	66	1.5	0.48	1.98
V_3	22	31	0.063	0.02	0.083
V_4	83	85	4.7	0.9	5.6

As a result of the early start of diode current in V_2 there will be a standing bias on V_1 and V_2, the mean value of which is approximately 0.5 V. This bias reduces the total cathode current of these two valves, and to allow for this the resistor in the h.t. negative line, which produces a bias for the output valve, has been specified as 560Ω. The bias for the output valve is then approximately −5.5 V, which, although slightly higher than the recommended value, results in only a slight decrease in the maximum power obtainable from the valve.



CLUB NEWS

Barnsley and District Amateur Radio Club recently celebrated its fortieth anniversary with a dinner to which representatives of a number of neighbouring clubs were invited. The president, G. Wigglesworth, a founder-member of the society, was in the chair. The club meets on the second and fourth Fridays of each month at 7.0 at the King George Hotel, Peel Street, Barnsley. Sec.: P. Carbutt (G2AFV), 33, Woodstock Road, Barnsley.

Brighton.—Under the title "A Novel T.R.F. Receiver," the Amos-Johnstone t.r.f. set detailed in our October and November, 1951, issues was described and demonstrated by Mr. Winyard at the meeting of the Brighton and District Radio Club (G3EVE) on December 8th. The club meets every Tuesday at 7.30 at the Eagle Inn, Gloucester Road, Brighton, 1. Sec.: R. T. Parsons, 14, Carlyle Avenue, Brighton.

Chester.—The new low-power transmitter of the Chester and District Amateur Radio Society (G3GIZ) is now being operated on 80 metres and in the top band. Meetings of the club are held in the Tarran Hut, Y.M.C.A., Chester, on Tuesdays at 7.30. On the first and third Tuesdays of each month lectures are given in preparation for the forthcoming Radio Amateur Examination. Sec.: N. Richardson, 23, St. Mary's Road, Dodleston, Nr. Chester.

Cleckheaton.—The January meetings of the Spen Valley and District Radio and Television Society, which meets on alternate Wednesdays at the Temperance Hall, Cleckheaton, include films lent by the G.P.O. (13th) and a visit to the Service Bureau of the Electric Lamp Manufacturers' Association in Leeds (27th). Sec.: N. Pride, 100, Raikes Lane, Birstall, Nr. Leeds.

Coventry.—The transmitter of the Coventry Amateur Radio Society (G2ASF) has now been installed in the new headquarters at 9, Queen's Road, Coventry, where the club meets on alternate Mondays at 7.30. Sec.: K. G. Lines (G3FOH), 142, Shorncliffe Road, Coventry.

Wellingborough.—Meetings of the Wellingborough and District Radio and Television Society are held on Thursdays at 7.30 at the C.W.S., Silver Street, Wellingborough. On January 21st, G. A. Wilford will give a lecture-demonstration on "Some V.H.F. Phenomena." Sec.: R. J. Henty, 6b, Silver Street, Wellingborough.

SIMPLIFIED TRI-COLOUR C. R. TUBE

THE possibility of mass-producing tri-colour c.r. tubes for colour television at a cost not very much greater than that of equivalent monochrome tubes has been opened up by an improved type of tube recently introduced in the U.S.A. Made by CBS-Hytron, a division of the Columbia Broadcasting System, it works on the same principle as the well-known RCA tri-colour tube,* that is, using a mask with perforations through which the three electron beams are directed on to their appropriate colour phosphors. The mask in the new tube, however, does not require heavy spacing rings to keep it stretched out flat in front of the phosphors: it is merely held in place, without stretching, by three suspension points at 120-deg intervals around its periphery. An important distinguishing feature of the mask is that it is curved rather than flat—the object being to reduce faulty registration of the electron beams with the phosphor dots at the outer edges of the picture.

Another saving in material is made by depositing the groups of phosphor dots not on a separate glass plate but directly on the inside surface of the tube face. This is done by a photo-engraving technique which is said to permit greater speed in production than the previous silk screen process.

According to *Tele-Tech* (in the November, 1953, issue of which the tube is described), the "Colortron," as it is called, gave excellent results "more than comparable with that noted on tubes of other manufacture" when it was tested on a closed circuit using colour slides as a signal source.

* *Wireless World*, October 1950, p. 367.

TELEVISION INTERFERENCE

AT intervals, discussions have taken place between representatives of the Post Office and the Radio Society of Great Britain on the question of interference from amateur stations with television receivers. The discussions have been with particular reference to cases where there is no appreciable harmonic radiation from the transmitter and the only emission is within the amateur bands.

Due to inadequate selectivity and "other undesirable features in the design" of some television receivers, signals from an amateur transmitter can cause interference due to (a) image response within the amateur band; (b) leakage into the i.f. amplifier where the pass-band of the amplifier embraces the amateur band, and (c) cross modulation and blocking in the early stages of the receiver. At the early meetings the Post Office took the view that the responsibility for causes, (b) and (c) must be borne by the amateur, and that he, therefore, had to close down during television transmitting hours until such time as the receiver was modified.

At a more recent meeting it was pointed out by the R.S.G.B. that despite representations to the industry some modern receivers have i.f. pass-bands which embrace amateur transmitting frequencies or suffer from cross modulation when in the vicinity of a transmitter. It was, therefore, suggested by the Society that where the trouble could be remedied by modifications to the receiver the amateur should not be held responsible.

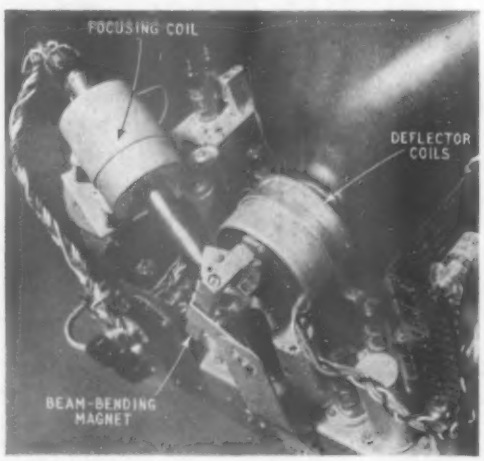
The Post Office has recently reviewed its policy on amateur interference with sound and vision reception and has decided to continue the present arrangement until the end of September, 1954, to enable manufacturers to introduce the necessary modifications in receiver design. After that date, the G.P.O. will continue to expect the amateur to suppress all harmonics outside his authorized bands, but once this has been done, if the wanted signal "is a good one" and the interference is due to choice of the i.f. for the complainant's receiver, or to the image response of his receiver, the G.P.O. will allow the amateur to continue operating after an interval of one month from the date on which the cause of the trouble is notified to the complainant by the Post Office.

The R.S.G.B. states that the Post Office does not feel justified in automatically applying the same arrangement where the interference is proved to be due to the close proximity of the amateur station to the complainant's receiver. In such cases the amateur will continue to be expected to prevent interference.

These new arrangements will be confined to areas in which the television signal is good. So far as fringe areas are concerned the Post Office wishes to make it clear that it will have to look to amateurs to cease any interference which their operations might cause in those areas.

FOLDED-UP C.R. TUBE

TELEVISION sets with large screens are obliged to have rather deep and unwieldy cabinets to accommodate the considerable length of their picture tubes. By bending the neck of the tube back on itself, however, and using a small permanent magnet to deflect the electron beam round the bend, it is possible to reduce the depth of the cabinet to less than the diagonal of the screen. This has been done as an experiment by the Philips research laboratories at Eindhoven, and they have built a 16-in receiver, which, with a width of 20in and a height of 14½in, has a depth of only 13¾in. In fact, it is no larger than a medium-sized sound broadcast receiver. As the bent part of the tube can be somewhat longer than that of an equivalent straight tube the focusing in this arrangement can be made correspondingly better than normal. Moreover, the focus coil (see picture) can be made long and narrow, and by bending the neck through an angle greater than 90 deg the thickness of the coil can be kept within the overall front-to-back length of the tube. It goes without saying, of course, that the bend in the neck and the beam-deflecting magnet together act as a very effective ion trap. J. L. H. Jonker describes the scheme more fully in the June, 1953, issue of the *Philips Technical Review*.



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Important Announcement

ABOUT acos HGP 40 AND GP 20 PICK-UPS

We will be frank with you. When we evolved the now famous Hi-g pick-up tracking principle, we felt that it called for the introduction of an entirely new pick-up, complete with arm and new style heads. We called this pick-up the HGP 40.

The interest in the HGP 40 has been tremendous, but it is already clear that there are thousands of owners of that most popular of all crystal pick-ups—the GP 20—who wish to bring it up to date by changing the existing head (GP 19 or GP 19LP) for an HGP 40 head (standard or LP). It cannot be done.

However, we bow to public demand. We are discontinuing the HGP 40 as such. Instead, we are now producing the HGP 39-1 (STD. or LP) pick-up heads to fit the GP 20 arm. Its response will be substantially the same as the HGP 40 and the sapphire stylus is easily replaceable. Its price is £1/12/-, plus 10/3 P.T.

To sum up :—
HGP 40 pick-up is discontinued.
HGP 39-1 (STD. or LP) heads are available to modernise the GP 20.
GP 20 fitted with the HGP 39-1 head will in future be known as the GP 20/Hi-G.

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The American Television Scene

An Engineer's Impressions of Recent Happenings

By M. J. L. PULLING*

NO one who is in any way directly concerned in television affairs could spend a month in the U.S.A. without being immensely stimulated. Infuriated he may be by some of the things he sees on the screen, but the ebullience, the vitality of the whole business of television in that astonishing land is highly infectious. The visiting engineer, in particular, is bound to find much to interest him. In the technical field so much is going on in so many places. And American engineers are generous—generous with their time, generous with their information and with their help.

All these are solidly based impressions, formed as a result of an immersion in the atmosphere of American television, radio and electronics generally, for a period of a month. Generalities are notoriously dangerous and any attempt to put on paper one's conclusions after so short a visit is bound to lead to a quota of such generalities, but the discriminating reader will know how much discount to apply to these.

First of all, then, for monochrome television, and there is plenty of it: in New York, from 6 a.m. till after midnight, there is usually a choice of seven programmes. The fact that the American picture standards are 525 lines with 30 complete pictures per second, giving a line-repetition rate of 15,750 per second as against ours of 10,125 per second, should lead to a more detailed picture with less flicker by contrast to ours. Personally I did not find the difference striking—certainly not unless I consciously thought about it. Possibly the fact that one is generally looking at larger screens than in England tends to offset the effect of the greater number of lines. For 21-in tubes are the current best sellers; 17-in tubes are still being sold but the trend in sales to the public is still upwards. Many people whose views command respect seem to think that with 21-in the upper limit of tube size for the "average" receiver has been reached. On the other hand, the same prediction was made about the 17-in tube and soon proved false. But perhaps the argument that the adoption of 24-in or larger tubes produces a receiver so large that it will not readily go through the doorways of an average home is a valid one. Certainly, I would not myself get very enthusiastic about a screen size much greater than 21-in.

Projection-type receivers appear to have vanished—and indeed it is difficult to see how they could effectively compete against receivers with 21-in direct-viewing screens costing around $250 to $300.

The quality of pictures seen in studio control rooms, at its best, is impressive, especially on important programmes, for which pick-up tubes would be specially selected. But there is a certain monotony in the type of picture produced, simply because no pick-up tube other than the Image Orthicon is used in any studio or in any outside broadcast equipment in the U.S.A. In this respect we have a marked advantage in this country with our variety of different types of pick-up tube.

The network of vision circuits which now covers the country has reached the fabulous figure of 40,000 circuit miles, and the switching of programmes between sources hundreds and even thousands of miles apart, on exact time cues, is carried out without any apparent trouble. The majority of these links are by radio, using centimetre or decimetre waves, with a bandwidth of 4.5 Mc/s, while coaxial cable circuits have a smaller bandwidth of 2.7 Mc/s. The quality of pictures received over the coast-to-coast radio link of 3,000 miles is remarkably good under normal conditions, though trouble is sometimes met with when atmospheric conditions cause deep fading on one or more sections. There is little doubt that the performance of the permanent vision links is of such a high order that distortion introduced by them would pass unnoticed on any but the highest class of receivers—it being noted, though, that the performance of the American receiver is, by and large, less good than that of a British receiver in the corresponding class.

The television industry is now rapidly readjusting its outlook to take in the colour scene. The remarkable success of the demonstration staged in New York on October 15th is now history. This demonstration was the climax of 18 months' work by the National Television System Committee. The Committee had said in effect "We have devised a truly compatible system of colour TV which is immediately applicable to existing v.h.f. and u.h.f. transmitters with only minor modifications and to existing vision links, provided proper colour cameras and equipment and colour receivers are used." And October 15th was the date set for a great "showing up of home work" to members of the Federal Communications Commission, the body which regulates all such matters in the U.S.A.

The American TV industry is evidently not superstitious, for 13 colour receivers—one from each of 13 different manufacturing firms—were on show. Pictures came from a studio, an outside broadcasting unit and a colour slide scanner during a demonstration which lasted about two hours. Even making allowance for the fact that the receiver tubes were all 12 in, and therefore small by monochrome standards, the subjective effect of the colour pictures was most pleasing on the majority of the receivers for the majority of the time. There were times when the colours were garish and there were receivers on which the tone rendering was poor, but these were rather the exceptions.

A comparison with colour films is natural enough and here it must be admitted at once that modern

* British Broadcasting Corporation.

colour films are definitely superior. But when one remembers the comparative crudity of early colour films, the present state of the art in colour television is not to be despised. Of course this was an important demonstration and of course there was an immense amount of very high-grade engineering effort and technical competence behind it. It was scarcely representative of the conditions which exist in normal day-to-day broadcasting. But, as against that, it would be hard to find a more highly critical audience or an occasion which, by its very importance, would be more likely to give rise to the sort of gremlins which visit all complex technical gear at times.

None the less, the whole performance went through without any evidence of significant technical blemish. For this achievement alone the American electronics industry and broadcasting companies deserve our respectful congratulations.

Each receiver was allowed one attendant, but it was noticeable that little manipulation of the controls seemed to be needed to keep the pictures in adjustment. At each end of the room there were monochrome receivers working off the colour signals. These gave results at least as good as would be expected from a monochrome signal. In parenthesis there would be good reason to expect the results on monochrome receivers to be satisfactory since these were probably hand-picked receivers and also because the camera pick-up tubes used for these tests were also, no doubt, very carefully selected.

For the greater part of the time the programme came from nearby sources, via normal monochrome broadcasting transmitters adapted for colour, direct to the receivers. But at one stage in the proceedings, we were shown the effect of switching first 540 miles of radio links and then 500 miles of coaxial cable into circuit by diverting the signals to Washington and back on each of two routes. The effect of the radio links was not noticeable at a normal viewing distance, but the cable introduced some loss of definition and showed some evidence of phase distortion.

There is a further aspect of the demonstration which calls for comment, namely the performance of the colour receivers on a monochrome input. In this respect, performance was more variable. On all receivers the pictures had a definite tint, and this tint, though constant on any one receiver, varied between receivers, and tended to be more marked round the edges than it was near the centre, due probably to slight errors in registration. It is difficult to say to what extent this effect could be tiresome in practice, or, to put it another way, how easily the eye would accustom itself to this condition. It is undoubtedly an important factor, since the average person who buys a colour receiver will trade in his monochrome receiver, and for a long time—perhaps always—a proportion of programmes will continue to be transmitted in monochrome.

The only noticeable omission from the programme was the transmission of film. This, however, was seen at a later date when a British 16-mm colour film was used as part of the programme on November 3rd, when R.C.A./N.B.C. demonstrated the transmission of colour pictures across the continent, the programme originating in New York and being viewed by an invited audience in the N.B.C. studios at Burbank, outside Los Angeles. The results obtained from the colour film, as seen at the sending end, were highly satisfactory.

The American television industry is fairly confident that the N.T.S.C. compatible colour standards will be approved by the F.C.C., probably by the end of the year or soon afterwards. If this happens, 1954 should see the start of serious colour broadcasting in the U.S.A. It will be slow at first, for both studio equipment and receivers will be available in only small quantities, but the end of the year might see about 2 hours a day in colour on the principal networks and perhaps 25,000 to 50,000 colour receivers with 12-in tubes in use.

Another aspect of television which has been attracting much attention recently is the attempt to record video signals on magnetic tape. A few years ago, when it was considered by sound-recording engineers as something of an achievement to record frequencies up to 15,000 c/s on magnetic tape, the very suggestion of recording a waveform which contained frequencies up to 3 or 4 Mc/s would have been dismissed as absurd. Yet the potential importance of a practical solution to this problem was felt to be so great that several firms tackled it. This importance arises from the useful attributes possessed by magnetic recording systems. First, that by comparison with systems of recording the image on photographic film, no processing (with attendant time delay) is required between recording and playback. Secondly, that it is possible to check the recording for quality while the recording operation is in progress. Thirdly, as soon as a particular recording is no longer needed, the tape can be magnetically wiped and used again. These attributes are significant enough in relation to the recording of monochrome pictures. They are far more significant when it comes to recording colour pictures, where the cost and complication of using colour film might well be prohibitive. R.C.A. announced on November 3rd that it had achieved magnetic tape recording of both monochrome and colour programmes. On December 1st the present state of the art was demonstrated at their laboratories at Princeton.

The demonstration appears to have been successful both in monochrome and in colour. When direct comparisons between the original picture and its recorded reproduction were possible, some degradation could be detected, but R.C.A. made it clear that they did not consider the system to be far enough advanced for commercial exploitation. They thought the present development programme would occupy a further two years. The width of the tape is $\frac{1}{2}$ in and its speed is 30 ft per second, which gives a playing time of 4 minutes for a 17-in diameter spool.

Other firms are known to be working on this problem and it seems fairly certain that the system will have a profound influence on current practice in television recording and may well affect the motion-picture industry as well.

So far as television is concerned, it is worth noting that this system records and reproduces the electronic signal, or something closely approximating to it. Its principal application, therefore, is likely to be in respect of programmes to be reproduced in the country in which the recordings are made, or in another country using the same television standards. Recordings would not be suitable for reproduction in a country using different standards unless, in addition, some form of standards converter were used, with consequent additional distortion.

Some of these latter-day developments of the prolific electronics industry which has been built up in

the U.S.A. are still just below the horizon so far as the experience of the average man goes. But I can, I am glad to say, report one innovation which, to quote the persuasive gentleman who suddenly appeared on my screen after 10 minutes of a one-act play, is "new, revolutionary, and in your dealer's window." He was trying to persuade me to buy the latest model of a well-known brand of television receiver which, it appeared, ". . . . embodied this unique device, the product of months of tireless research . . . etc., etc." With mounting excitement I listened to the catalogue of its virtues. What could it be? The suspense was intolerable . . . "call your dealer to-day and ask for a demonstration of the marvellous new XYZ . . . (pause for effect) . . . THE ELECTRONIC CLARIFIER."

Inductor Suppressors

Eliminating Television Interference From Electric Motors

By F. R. W. STRAFFORD,* M.I.E.E.
and R. R. TEESDALE *

AFTER motor-car ignition systems the most serious source of interference to television reception is the fractional horse-power commutator motors which are widely used in small domestic appliances, such as sewing machines, hair-dryers and vacuum cleaners. These are, in fact, responsible for about 50 per cent of the complaints received by the Post Office Radio Branch.

Most domestic appliances can be suppressed very effectively by fitting capacitors and inductors inside the machine frame. In most cases, however, the procedure is complicated because there is insufficient space in which to house the suppressor unless radical design changes are effected. Even then the services of a skilled technician are required if a workmanlike job is to be done which will be free from introducing shock hazards in the event of an unearthed appliance being used in "earthy" conditions. For these reasons, the possibilities of flex-lead suppressors have been investigated, and it has become apparent that two small inductors, mounted in the mains leads fairly close to an appliance, can, in a great majority of cases, be surprisingly effective.

Considering the two input terminals of the mains operated appliance, we may apply Thevenin's theorem, and regard the motor as an r.f. generator in series with its own impedance. In Fig. 1, the motor generates, at a given frequency, an open circuit interfering e.m.f. E_i. Here Z_g is the effective generator impedance and Z_m the mains impedance.

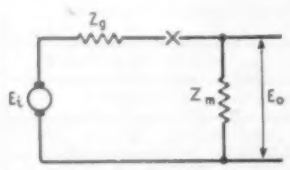
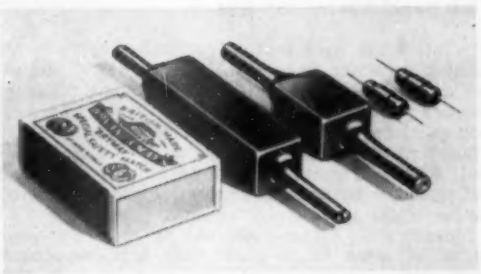


Fig. 1. Showing the interfering motor as an r.f. generator feeding into the mains.

* Belling and Lee, Ltd.



Inductor suppressors compared in size with a matchbox. On the left is a cut-lead type containing terminals and cable grips, in the middle is a smaller unit with leads moulded in, and on the right are two inductors for wiring directly inside an appliance.

The e.m.f. passed into the mains, E_o, is given by :—

$$E_o = \frac{E_i Z_m}{Z_g + Z_m}$$

Suppressors usually comprise capacitors and inductors. One simple form consists of a low-impedance capacitor which is shunted across Z_m. Thus, if the capacitor impedance is Z_c, and is small compared with Z_m or Z_g, the output voltage becomes

$$E_{o1} \doteq \frac{E_i Z_c}{Z_g}$$

When a single high-impedance inductor is used it is inserted in series with Z_g at X. If the inductor impedance is Z_L and is much greater than Z_g or Z_m the output voltage becomes

$$E_{o2} \doteq \frac{E_i Z_m}{Z_L}$$

Obviously capacitors are efficient when used to suppress high-impedance machines, and inductors should be used with low-impedance machines. Most small motors possess a high impedance at low frequencies, which falls (often substantially linearly) as the frequency increases. For example, a typical two-wire hair-dryer showed an impedance of 13,000 ohms at 200 kc/s and 40 ohms at 60 Mc/s. These figures explain why capacitors are very suitable for suppression on sound broadcasting frequencies but suggest that they may fail at higher frequencies. Experiment confirms that capacitors alone are seldom effective as v.h.f. flex lead suppressors, excepting the special bushing types where large values of capacitance may be achieved without inductive losses.

There is another reason for the failure of capacitors

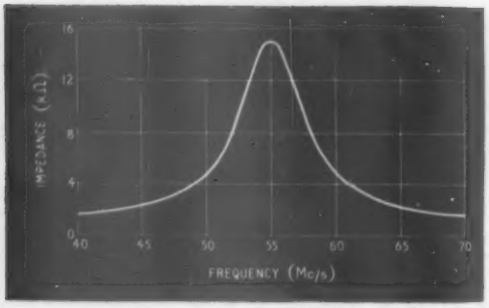


Fig. 2. Impedance characteristic of inductor suppressors over the television frequency band.

at v.h.f. when used in this particular manner. A suitable capacitor behaves as a short-circuit across the mains leads, so that the short length of cable between the appliance and the capacitor behaves as a loop energized from a low-impedance source. Thus, a a heavy r.f. current flows in this section of the mains lead. Radiation and induction fields are then produced and these can by-pass the suppressor and re-energize the remainder of the mains wiring.

Inductors are far less affected by the by-passing action of stray fields since their high-impedance limits the magnitude of r.f. current flowing in the section of the mains lead close to the appliance, and they separate the two sections of mains cable one from the other in the electrical sense.

The properties of an inductor suppressor are best described by reference to its impedance characteristic over the range of frequencies involved. This is controlled by the self-capacitance of the coil which, by design, is made to resonate at the mid-band frequency or near to it; at this point the impedance is high and the suppression is greatest. Fig. 2 provides this information for the inductors described. For the purpose of assessing the degree of suppression likely to be introduced it is convenient to regard the mains lead to the appliance as an r.f. feeder with an approximate characteristic impedance of 150 ohms. By dividing this value into the impedance of the inductor the ratio expressed in decibels gives a fair approximation of the degree of suppression introduced. The formula is:

$$N_{db} = 20 \log_{10} \frac{\text{Impedance of inductor}}{150}$$

If this is used in conjunction with the graph (Fig. 2) it will be seen that the suppression is in excess of 20db over the present five television channels and rises to about 40db at the mid-band frequency.

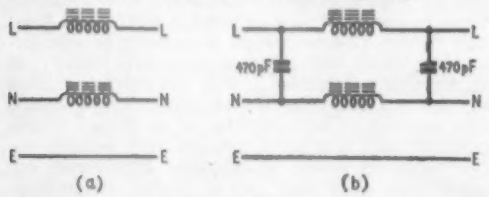


Fig. 3. Two types of suppressor tested, (a) Inductor suppressor, (b) twin π suppressor.

Subjective tests which have been carried out in conjunction with laboratory experiments have confirmed that inductors should behave as efficient flex-lead suppressors. The tests were done on six typical domestic appliances which were chosen from a larger number and were known to produce severe television interference. Two suppressor circuits were tested as shown at (a) and (b) in Fig. 3. The inductors were single-layer solenoids wound on dust iron cores. They had an inductance of 8-9μH, a self-capacitance of about 1 pF, and were self-resonant at 55 Mc/s.

Five observers carried out tests at their homes. In each case they were done at as many different mains outlet points as possible. The receiver was kept in the same position throughout and no adjustments were made to the contrast and brilliance controls once they had been set for best reception when interference was not present.

The interference levels were compared with, and without, the suppressor in circuit in accordance with the following nine-division code.

(1) Picture obliterated—impossible to identify it.
(2) Picture identifiable but of no entertainment value.
(3) Very heavy interference.
(4) Heavy interference.
(5) Moderate interference.
(6) Annoying, if interference present for long periods.
(7) Perceptible but hardly ever annoying.
(8) Just perceptible—does not attract attention.
(9) No observable interference.

The table gives the results of the tests in terms of these interference levels, the figures being rounded-off averages for each appliance. It will be noted that the suppressor using inductors only is the better of the two. The effect of connecting and disconnecting an earth lead, where such provision existed, has also been taken into account. In general the effect of earthing a 3-core appliance was to increase slightly the general level of observed interference.

It is a general rule that a flex-lead suppressor should be fitted as close as possible to the source of interference. The reason for this is that the stray fields which radiate from that part of the mains lead connecting the appliance to the suppressor increase rapidly in magnitude as the filter is moved away from the appliance. It will be apparent from earlier remarks that the efficiency of inductor suppressors is much less dependent upon their accurate positioning than that of capacitors. However, it is good practice to insert the suppressor within 6in of the appliance.

TABLE OF AVERAGE INTERFERENCE LEVELS

Appliance	π Suppressor		Inductors only	
	Unsuppressed	Suppressed	Unsuppressed	Suppressed
Hair dryer (2-core) ..	3	6	3—4	8—9
Hair dryer (3-core) ..	2	5	4	7
Sewing machine	6	8	6	8
Vacuum cleaner	5—6	8	6—7	9
Fan	5	8	3	8
A.C./D.C. motor	3	6—7	4—5	9

THE "BELLING-LEE" PAGE

Providing technical information, service and advice in relation to our products and the suppression of electrical interference

A Question of Location.

An architect is surely a practical man, i.e., who creates a pleasant and essentially useful building out of the material of his choice. We have often come across architects who do not hesitate to deprive their clients of the full benefits of television because they feel that the presence of a T.V. aerial spoils the skyline of their creation. We are not here to extol the beauties of a T.V. aerial, but if the best results are to be expected from a television receiver, the aerial should be sited to provide the most efficient signal. It is only bad advice based on ignorance when someone is told that the position of an aerial does not matter. In a location of strong signal it may not matter, but if there is interference, or a weak signal, the architect is generally no more qualified to say where the aerial should go, than we are to build a house.

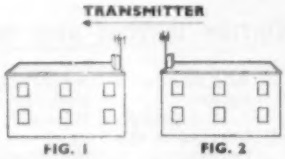


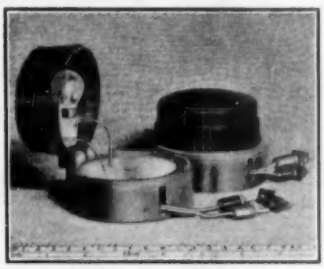
FIG. 1 FIG. 2

We had an interesting case recently, where it was insisted that the installation of a T.V. aerial should be at the back of the house over 100 miles from a transmitter. See Fig. 1. To complicate matters the house had a large flat lead roof. The results were useless, and we were called in to see if we could provide an acceptable signal. Without hesitation, we moved the aerial to the front of the building, nearest the transmitter, see Fig. 2, and without any further work the signal was adequate. The aerial in use had a high back-to-front ratio, and as we left it, the dipole didn't "see" the lead roof because of its reflector, the net result was similar to increasing the effective height of the dipole.

A Novel Application for a Bi-metal Thermal Switch.

"Belling-Lee," as readers know, manufacture a range of thermal switches, the latest application is the "Save-a-Life" Work and Warning Light. This is for motorists, and is complete with two dashboard sockets intended to be connected to the battery terminals. Plugged in, and placed in the road, the "Save-a-Life" floods the user and the car with a 24 watt broad beam white light, making him fully visible and providing adequate working light for wheel changing, etc.

The novelty lies in the flashing red warning light directed towards following traffic. Any reader who is interested should write for leaflet S1353.



"Save-a-Life" Work and Warning Light. List No. L1315/6 and /12 volt.

"Belling-Lee" have recently joined the Society of Motor Manufacturers & Traders, and have formed a Motor Accessories Division. This section of the business will also market automobile fuses, "Sparkmasters," and car aerials, also other suitable lines as they become available.

Television Society Experimental Transmitter.

By the time you are reading this, we expect the transmitter will be "on the air" from Norwood Technical College. The power will be low, about 80 watts and we believe that 15 miles will be fringe reception.

"Belling-Lee" have developed a receiving aerial which may either be mounted with an "H" as shown, or where an indoor aerial is being used for reception of B.B.C. Television the array is supplied with a light cranked arm and bracket for lashing to chimney as illustrated at foot of centre column.

Alternative T.V. Programme.

This will of course be in band 3. Aerials of these dimensions are not new to "Belling-Lee" who have developed band 3 aerials for Continental markets, and which will be made available here whenever required.

Will those in coastal towns, fishing ports, yachting centres, etc., bear in mind that "Belling-Lee" are specialising in suppression on board ship.
We have done such work on ships of all sizes from the "Queen" class to trawlers, drifters and yachts.

Written 27th November, 1953

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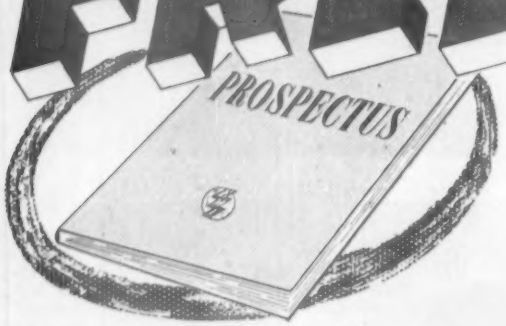

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IC18

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

"*Wireless Fifty Years Ago*"

ARTHUR MORSE'S comments in your October, 1953, issue on Maurice Child's delightful article (*Wireless World*, August, 1953) about early spark wireless days, raises a point on which I would like to comment. Mr. Morse refers to "the importance of carborundum, which was the preferred detector in commercial practice until the advent of de Forest's triode." Quite true, but one should add that carborundum was also the preferred detector in commercial practice for many years after the advent of de Forest's triode in 1906. This preference continued until after 1912, when the invention of the reaction or regenerative circuit brought on the era of modern radio.

It is worthwhile keeping this period of history straight because there is an important lesson to be learned from it. For six long years, the secret of modern radio lay obscured by de Forest's erroneous explanation of how the triode operated; i.e., that positive or negative voltages applied to the grid produced alike a reduction in the current through the tube. This theory was accepted as the explanation of the detection process that was observed. It precluded the idea of amplification, a thought which might have occurred to someone if the grid voltage/plate current relationship had been correctly stated, and it had the result that for years no one made a serious study to find out how the "audion" really worked. The use of the triode in commercial practice was confined to that of detection, perhaps 50 per cent more effective than the crystal, a point of so little importance that not a tenth of one per cent of the stations in operation were fitted with it. Seven leading textbooks, published before 1914, comprising in all over 3,000 pages, devoted less than one page of aggregate space to the "audion"!

The lesson is clear—anyone of us with a volt meter and potential divider to apply known voltages to the grid of a triode, and a galvanometer to measure the changes in its plate current, could have started unravelling the "audion's" mysteries long before we did start—*had we not known too many things that were not so.* The present generation is learning the same lesson over again from the advent of the transitor. We had the crystal for a longer period of time than we had the triode without suspecting its major use could be anything other than a detector; until the man appeared who questioned what everyone else "knew."

Where could we find better examples of the wisdom of those immortal words set down four centuries ago?

"There are more things in heaven and earth,
Horatio, than are dreamt of in your philosophy."
(*Hamlet*, Act I, Scene 5).

EDWIN H. ARMSTRONG.

Columbia University, New York, U.S.A.

Television Aerials

MY first perusal of F. R. W. Strafford's article (your November issue) filled me with alarm and despondency. I could imagine the public reaction to the suggestion of erection of Christmas-tree-like structures upon their property.

Consequently, I read the article again with a view to finding a glimmer of hope. The result was not any more comforting than the first time. It was whilst pondering over the possibility of improving matters by the use of half rhombics and tilted wire aerials, etc., that I realized that although the pictorial representations implied a striving after gain, the mathematical considerations of the article were concerned in losses. This raised a further question, i.e., "Are we becoming slaves to the decibel?"

It would certainly appear so at the moment as the following example will show:

Assuming a frequency of 50 M/cs, a signal strength of 100 microvolts per metre, with H-type aerial and cable of 4 db loss per 100 feet we obtain at the receiver a signal of 137 microvolts for 50 feet run of cable.

Now suppose we double the loss by using a less efficient aerial or cable of 8 db per 100 feet. We now get a signal at the receiver of 108 microvolts. Nowadays it is a relatively poor receiver which will not produce peak white for 100 microvolt input, particularly the "fringe" type.

Thus it will be observed that the "alarming" loss that 2 db is generally supposed to cause is neither here nor there with a modern receiver.

The conclusions to be drawn from this are obvious. Free ourselves from the domination of the decibel and aerial installations, both present and future, can be less cumbersome and less expensive.

Scarborough, Yorks. H. WILLAN CRITCHLEY.

The author of the original article writes:

Mr. Critchley has drawn certain conclusions from my article and flattered me to the extent of reading it twice, but I will not be diverted from my avowed intention not to enter the political field.

On the second and technical issue concerning decibel fetishism, I am on safer ground and hasten to assure Mr. Critchley that, in certain circumstances, 2 db is a very useful increment when applied to vision reception, and 1 db is not to be sneezed at, either!

If Mr. Critchley will adjust his receiver for maximum sensitivity and insert an *accurately* calibrated step-by-step attenuator in series with the input connection from his aerial feeder, and furthermore adjust the attentuator so that the picture is just tolerable (that is, does not slip synchronism), he will find that the introduction of a further 2 db attenuation will result in an unstable, useless picture.

Repeating the experiment at a somewhat higher signal level, but in the presence of thermal and Schrott noise, he will find that an increase of 2 db will markedly improve the picture quality.

If an *aerial* gain of 2 db is achieved by the addition of parasitic or driven elements, it is axiomatic that the directional response of the aerial will improve, so that, apart from the 2 db increase in signal, there is a reduction in the ambient noise, man-made and terrestrial, and consequent improvement in signal-to-noise ratio which, after all, is a basic criterion of any communication system.

F. R. W. STRAFFORD.

Recording and the Law

YOUR leading article in the December issue raises an interesting point about the illegal recording of broadcast music. If a person is taken to court for pirating a broadcast of, say, a classical symphony, it will presumably be necessary to establish where he got it from, since the copyright applies to the performance and not the music, which is automatically "out of copyright." This is going to be difficult, to say the least. If I take my tape recorder to a Cup Final and put on Beethoven's Seventh Symphony, I may be taken to hospital, but I am not likely to be taken to law, at least not with any satisfaction to the prosecution. It may be years since I made the recording: there have been hundreds of performances of it since. Who is to say whether I got it from the B.B.C., from a foreign station, from some records a friend brought from the U.S.A., or merely synthesized it from the outputs of a number of oscillators?

I imagine there must be many music lovers who, like myself, use a tape recorder to transpose the excellent

music which the B.B.C. regards as fit background for lunch and tea to the evening hours when it is more concerned with improving my musical outlook. I play it back to an audience consisting of other cases of arrested musical development, refugees from television, and anyone else who happens to be interested. I invite the B.B.C. to prosecute me. E. G. HARRISON.
Nottingham.

MANY thanks for your clear exposition (December issue) about home recording and the law.

One wonders by whom the B.B.C. and *Radio Times* had been "asked to remind listeners" in the lop-sided way that ignored the protection of freedom given by Parliament in the proviso to Section 1, Dramatic and Musical Performers Act, 1925? And will they publish a correction to maintain fairness of presentation about a freedom?

Authority has demonstrated it is rather addicted to that kind of thing. Here is an example.

Television showed the "War on Pirates." The detector van went out searching. Did they catch a "pirate"? No. They "caught" licensed viewers and under suasion of a Post Office warrant demanded production of licences. A fine example of the use of authority to do an unnecessary thing, when a glance at the register of licences would have sufficed.
Mansfield, Notts. A. H. COUPE.

Reflex Push-pull Receivers

In his article in the November number, G. J. Pope has overlooked the shunting effect of the input resistance of V_1 across R.

In the absence of V_1, the voltage across R is about equal to that between grid and cathode of V_2, since the output impedance of V_2 ($\simeq\frac{1}{g_m}$) is about equal to R. The cathode of V_1, however, also presents a resistance $\simeq\frac{1}{g_m}$ across R. (The value of $\frac{1}{g_m}$ is that obtained when the screen current is included.)

Thus the input voltage will divide in the ratio of two-thirds to V_2 to one-third of V_1 and R in parallel. To put it another way, the signal current flowing in V_2 will divide equally between V_1 and R. It is clear that the full output power will not be available.

This circuit does, however, ensure that V_1 is not likely to be over-driven; so that one source of distortion peculiar to reflex circuits is avoided.

To improve the balance of the push-pull pair, R should be made large compared with $\frac{1}{g_m}$, or replaced by a suitable choke, appropriate arrangements being made for grid bias.

Since the detector circuit is transformer-coupled from the anode of V_1, it may be returned to the cathodes of V_2 and V_1 instead of to chassis. In this case the feedback effect of the push-pull coupling is avoided, and increased sensitivity will be obtained. The output will, however, have the distortion characteristics of a single-ended stage.

Incidentally, in view of the high modulation depths frequently used by the B.B.C., it would be better to make the diode load the volume control, replacing the existing 2-MΩ one by a 1-MΩ fixed grid leak to reduce detector distortion.
Malvern, Worcs. G. F. JOHNSON.

Anode and Cathode

THE correctness or otherwise of the Oxford English Dictionary's definition of the anode of a cell depends upon how it defines an electric current and I have had no opportunity of verifying this. It is correct if the O.E.D. regards an electric current as a flow of electrons and disowns the regrettable "positive current." Should this indeed be so, Oxford is to be congratulated. One cannot, though, help feeling a little uneasy over such sponsoring of the electron current by the Home of Lost Causes.

As "Free Grid" implies (your December issue), this business of anodes and cathodes is apt to be rather confusing. Which pole is which depends upon whether one is referring to what goes on inside a generator or to what takes place in the circuit which it feeds. No bad way of obtaining a clear picture is to think of a diode rectifier as a generator of d.c., using the old (and possibly happier) names of filament and plate for its electrodes.

Inside the valve electrons flow from filament to plate: the former is here the cathode and the latter the anode. But in the external circuit the electron flow is from plate back to filament. The positions are now reversed, the plate being the cathode of the generator in the circuit—the departure point of electrons—and the filament, as their arrival point, the anode.

Replace the diode generator by a Leclanché cell. Matters are now a little more complicated, for, instead of a flow of electrons from the electrolyte to the can, there is a movement of positive zinc ions in the opposite direction. The result, however, is the same as if there were a flow of electrons to the can; and the can is the anode.

A further complication is that the cell is a two-part affair, the electrolyte being the cathode of Part 1. In Part 2, there is a similar flow of positive ions—hydrogen ions this time—to the manganese-dioxide element. Here, then, the electrolyte is the anode and the MnO_2 element the cathode. Since the two parts of the cell are effectively in series, its master cathode is the MnO_2 element and its master anode the zinc can. As in the case of the diode, the roles of these electrodes are reversed in the external circuit when the cell is under load.
Berkhamsted. R. W. HALLOWS.

Ignition Interference

I WAS interested in the opinion expressed by Malcom S. Morse of Rockville, U.S.A., in your October issue. This opinion called forth your Editorial article on page 445.

I believe that both Mr. Morse and your editorial miss the main point in discussing ignition interference to television, Mr. Morse believing that the interference is due to poorly designed British receivers, while your editorial suggests that the lack of ignition interference in America is due to the fact that the vehicles are effectively suppressed.

Surely one of the main reasons for bad ignition interference in Great Britain is due to the fact that, unlike America, the television transmissions are vertically polarized, and are in the main received on vertical antennas. The susceptibility of vertical antennas to reception of man-made and in particular, of ignition interference, is too well known to need any further elucidation. In the United States transmissions are horizontally polarized and horizontal antennas are not so prone to pick up this type of interference.

Secondly, it is a fact that the average British small car produces, for some undiscoverable reason, ten times as much interference as practically any American car. This point is well brought out in South Africa, where some 90 per cent of all cars in use are large American cars, practically all equipped with short- and medium-wave car radios, yet very few of the cars are equipped with anything except the most elementary form of suppression devices. On the other hand, any British car equipped with radio apparatus has to be lavishly equipped with every known suppression device.

In order to illustrate this, the writer's own vehicle, an

American car, is equipped with a receiver capable of covering 10-550 metres, with an average sensitivity of 1 mV. With this equipment it is possible to receive amateur and short-wave broadcasts of a low signal level even when travelling in normal suburban traffic, except when a small British car appears anywhere within 700-800 yards. In fact, over a period of time, I find it quite possible to state just what kind of British car is approaching me from the rear, without looking in the rear-view mirror, merely by listening to the racket which it generates in the receiver.

My own car is equipped with a noise suppressor only on the vibrating-reed type voltage regulator.

T. A. DINEEN (ZS6TP).

South African Philips (Pty.), Ltd.
Johannesburg, South Africa.

Technical Qualifications

I WAS most interested to read the letter appearing in your November, 1953, issue from Mr. P. B. Hayes. In the penultimate paragraph of this letter Mr. Hayes states that the British Institution of Radio Engineers grants holders of the full Technological Certificate of the City and Guilds of London Institute complete exemption from the Technical and Mathematics sections of the Graduateship Examination.

This is not quite true. In actual fact, holders of the full Technological Certificate of the City and Guilds of London Institute in Telecommunications Engineering are exempted from all except Part I of the Graduateship Examination; that is, Physics.

London, W.C.1. A. J. KENWARD,
(Examinations Officer, Brit. I.R.E.)

IN a short time I shall be due for release from the forces after completing my National Service.

This year I obtained a full pass in the Radio Trades Examination Board examination and I felt that I would prefer a servicing post in industry rather than with a dealer.

In recent months I have had a number of interviews with large industrial concerns after applying for such posts, and have found without exception that the interviewer has never heard of the R.T.E.B. certificate. The most common method of selection I found was by extremely simple oral or written questions.

Since the R.T.E.B. is recognized by the British Institution of Radio Engineers and other important bodies, I think industry would do well to note the qualifications required for the R.T.E.B. certificate.

Street, Somerset. M. E. INGERFIELD.

AS a subscriber to *Wireless World* since 1927 and set back some distance from the British scene, I have followed through the medium of your publication the gradually increasing chaos in the radio engineering educational field in Great Britain, which must, in the long run, militate against the efficiency of the radio industry in your country.

There was a time when it seemed "Radio Engineer" would be a title of professional status similar to "Civil Engineer," etc., and that radio engineers would be acknowledged by the public as professional men and part of the engineering profession as a whole.

Such an outcome, instead of the present sorry state of affairs, would have rendered the profession attractive to a greater proportion of the best brains of the country and there would be less concern expressed about shortage of suitable material at I.E.E. and other meetings.

Viewed from this distance, there does not appear to be any justification for the increasing multitude of engineering qualifications and associations and the situation must confuse the public, the student and the industry. The I.E.E. has tried to introduce some semblance of order into this chaos by defining the province of the engineer, the technician and the craftsman, but your advertisers, for example, continue merrily to confuse the whole lot or reverse the roles, either out of ignorance or with a view to flattering their potential customers. Is there any hope that Great Britain will fall in line with the Commonwealth and most of the other English-speaking countries and use the title "engineer" in a consistent manner throughout the range of engineering endeavours?

The news writers are not hard pressed to find more glamorous titles for the professional engineer when he merits attention; all they have got to do is to pick at random from the confusion already created, a technologist, technician, boffin, technocrat, applied scientist, back-room boy, designer, research worker, radio executive, technical expert, inventor or whatever takes his fancy. They *would* be hard pressed, however, to pick out genuine professional engineering qualifications from amongst radio's growing alphabetic array. But does it matter much if students and employers are further befuddled—or could they be?

"ENGINEER ABROAD."

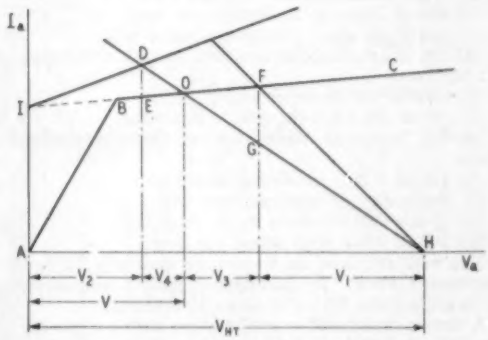
"*Voltmeter Loading Again*"

IN the October issue R. A. Wiersma stated in his article that the "one voltmeter three measurement" method cannot be applied to the case of non-ohmic resistance chains, and in particular cannot be used to measure the anode voltage of a pentode with resistive load. However, provided the voltage indicated by the meter when across the valve is higher than the "knee" voltage, the method is valid. This can be shown by considering the diagram.

ABC is an ideal pentode characteristic in which CB is assumed linear and is produced to cut the I_a axis at point I. From point H on the abscissa corresponding to h.t. voltage V_{HT}, load lines HD and HF are drawn. These correspond respectively to anode load R_L, and R_L shunted by meter resistance R_M. The line ID relates current and voltage when the meter is in parallel with the valve.

With R_L in series with the valve the working point is located at O and anode voltage is V.

When R_L is shunted by the meter the working point moves to F, the meter indicates V_1 and FG represents the meter current. When the meter shunts the valve the



working point becomes D, the meter indicates V_2 and DE represents the meter current.

Triangles DOE and FOG are seen to be similar, so that

$$\frac{V_2}{V_1} = \frac{DE}{FG} = \frac{EO}{FO} = \frac{V_4}{V_3} = \frac{V - V_2}{V_{HT} - V_1 - V}$$

Hence

$$V_2V_{HT} - V_2V = V_1V$$

and

$$V = \frac{V_2V_{HT}}{V_1 + V_2}$$

Thus, so long as D, O, F lie above the "knee" point B, the formula will give a result whose accuracy depends only on the linearity of characteristic to the right of B.

With a valve biased by means of cathode resistance the method furnishes "anode to earth" volts since the relevant characteristic has the same shape as ABC.

Enfield, Middx. D. CHAPLIN

Home-Made Transistors

Inexpensive Conversion of Selected Germanium Diodes

By P. B. HELSDON, A.M.Brit.I.R.E.

IT is quite practicable to make point-contact transistors at home which compare quite well with those advertised by professional manufacturers. The electrical ratings and characteristics of the type 2N32 represent an attainable target for home-made units. The real difficulty is to make two units with reasonably similar characteristics. Consequently circuits must be tailored to suit the individual transistor if best results are to be obtained.

Even the best available point-contact units require careful handling, both electrically and mechanically; home-made transistors are no exception. If a bought unit dies, that's the end of it, but home-made units can be repaired by rotating the crystal to a new spot and re-forming. One unit has been resuscitated at least six times after circuit mishaps. It now has a current-gain "alpha" of 3 and a collector impedance of 50,000 ohms. Assuming an emitter impedance of 500 ohms, this represents an available power gain of 23.5 db. The alpha cut-off frequency is about 3 Mc/s.

The following materials are required to make one point-contact transistor:—

(a) 1 germanium diode (see below).
(b) 6in of 20 s.w.g. tinned copper wire.
(c) 1in of 36 s.w.g. phosphor-bronze wire.
(d) ½in of ¼in diameter synthetic resin bonded paper (s.r.b.p.) rod.
(e) 1/16in of ¼in diameter s.r.b.p. rod.
(f) ½in of ⅛in i.d. × ¼in o.d. s.r.b.p. tube.
(g) 9in insulated tinsel copper flex (hearing-aid cord).
(h) ¼in of 1 mm insulating sleeving.
(i) Bee's wax or impregnating wax.
(j) ⅜in × 1/16in × 0.001in mica sheet.
(k) 8 B.A. brass grub screw ¼in long.

The tools required are those used generally for light instrument work. In addition, a pocket microscope of magnification 20 to 30 times is essential.

A simple ohmmeter in conjunction with a torch battery (4½ volts) and a 4.7 kΩ resistor is all the test equipment necessary. The ohmmeter should have an internal 9-volt battery and a half-scale reading of about 5,000 ohms. A Model 7 "Avometer" on the 1-megohm range is suitable. Assembly and forming jigs are described below.

The basis of the home-made transistor is a commercial high-reverse-voltage germanium diode. Diodes with a "turnover" voltage of 80 volts or more are usually necessary.

The basic physical phenomena which permits transistor action is "hole" storage. This is undesirable in diodes since it reduces the efficiency of rectification at high radio frequencies. Recently manufactured diodes appear to have been treated to minimize "hole" storage, consequently they make poor transistors. The best transistors are made from the glass-tube-enclosed type of diode made a year or two ago. The CG4-C and CG1-C with metal end caps and wire leads usually make good transistors. It is not necessary to use new diodes. Burnt out units are satisfactory as long as the crystal surface is unpitted and bright.

The first step is to clean the wax from the brass cap at the crystal (or red) end of the diode. The glass tube is gently broken and the cat's-whisker end of the diode discarded. Every precaution must be taken to avoid touching the face of the crystal since contamination from the fingers or tools may ruin it. The crystal is found soldered to a small brass mounting pin which is held in the brass cap by a set screw and a sealing compound. It is difficult to release the crystal by undoing the screw because the sealing compound holds it fast.

The crystal on its pin mount can be pushed out of the cap by means of a suitable jig and a vice. The jig consists of a metal plate at least ⅜in thick containing a hole (No. 2 drill) larger than the diameter of the glass tube but too small to pass the brass cap, and the shank of an old twist drill about 1/16in diameter. The cap containing the crystal is placed so that what remains of the glass tube is in the plate and the drill shank is then placed in the centre of the cap, behind the crystal. This assembly is squeezed in a vice until the crystal on its brass mount is ejected. The brass cap is discarded.

The crystal on its brass mount must be handled only by means of clean tweezers or small instrument pliers. Clean the remains of the sealing compound from the brass pin by scraping with a suitable tool. With a Morse No. 62 drill make a hole centrally in the base of the pin to a depth of 1/16in. Cut a 1in length of the 20 s.w.g. copper wire and quickly solder it into the hole. This is best done with the wire held vertically in the vice. Only "radio" 60/40 resin-cored solder of low melting point should be used, as acid fumes or excessive heat would spoil the crystal. Test the joint for strength. Slip a ¼in length of the 1 mm sleeving up to the joint. Solder 3in of the tinsel flex to the end of the wire, using a heat shunt if necessary to protect the crystal. If the crystal should have been contaminated by dust or soldering smoke it may be possible to clean it on a silicone-impregnated lens tissue.

The collector and emitter contact points are made from flattened 36 s.w.g. phosphor-bronze wire. Cut the wire to two ⅜in lengths. Straighten if necessary. Flatten the wires by hammering between two hard smooth steel blocks. The flattened wires should be about 0.002in thick. The points are ground with a hand-held carborundum stone.

The stone should be fine, clean and preferably new. Grind one end of each wire to an equilateral V-shaped point. Only a few light strokes are required. Examine the points under the microscope to see that they are

clean and sharp. The radius at the tip should be less than 0.0005in and the angle of the V about 60 degrees. The points should be as alike as possible. Do not touch with the fingers.

The body of the unit consists of a ¼-in length of the ¼-in diameter s.r.b.p. rod. The central hole in the body is drilled No. 44 or 45 to give a sliding fit for the crystal mounting pin. A radial hole is drilled and tapped 8 B.A. to meet the central hole about $\frac{3}{32}$in from the top face. Two holes symmetrical to the tapped hole are drilled No. 64, one on each side of, and parallel to, the central hole at a radius of $\frac{3}{64}$in. These holes must be a tight fit for the 20 s.w.g. copper wire. A ¼in long brass grub screw is fitted to the tapped hole.

Cut the 20 s.w.g. copper wire to two 2-in lengths and clench each piece about ½in from one end firmly in a pair of point-nosed pliers. The deformation of the wires ensures the necessary very tight fit in the body. Draw the wires into their holes in the body, with the short ends at the top, until they are immovable. The short ends are then bent through a right-angle in opposite directions tangentially and parallel to each other. The bends should be ¼in from the top face of the body. The bent ends are then cut to be within the projected circumference of the body. With a fine file make flats on top of the bent wires. These flats should be in one plane and parallel to the body face. Tin the flats with a soldering iron and remove excess resin. Cut the ends of the wires projecting below the body to a length of ¼in. Solder to each a 3in length of the tinsel flex.

A cap for the transistor is made from s.r.b.p. tube ¼in inside diameter, ½in outside diameter and ½in long. A $\frac{1}{16}$in slice of the ½in diameter rod glued into the top of the cap completes it. The cap should be a light push fit on to the body.

Each cat's-whisker must be bent to make an angle of just over 90 deg. The distance between the point and the bend should be $\frac{1}{32}$in less than the distance between the flats on the support wires and the top of the body. The angle to which the cat's-whiskers are bent is important. It should be as close to 90 deg as possible without actually being 90 deg or less.

The cat's-whiskers are soldered in place on the support wires by means of a simple jig. This jig consists of a brass 8 B.A. screw 1½in long, eased down if necessary to be a sliding fit in the central hole. The end of the screw is drilled centrally with a hole $\frac{1}{64}$in in diameter and $\frac{1}{16}$in deep. The jig is placed in the central hole to project $\frac{1}{32}$in above the top face of the body. Tighten the grub screw in the side of the body to hold the jig in place. The head of the jig screw projecting below the body can be held in a vice during the following soldering operation.

With tweezers lay one of the cat's-whiskers on a support wire so that the V-shaped point rests in the $\frac{1}{64}$in hole in the jig. Balance the whisker if necessary by cutting the unpointed end with a pair of scissors. The jig must be set so that the unpointed part of the whisker is parallel to the top face of the body. Solder by placing the iron for a few seconds in contact with the support wire a little distance away from the whisker. The whisker will settle down a little during this operation. The joint must be a strong one since it will be stressed after assembly. There must be no solder on the parts of the whisker not in direct contact with the support wire. This is to maintain the necessary springiness of the whisker.

The second whisker is placed on the other support

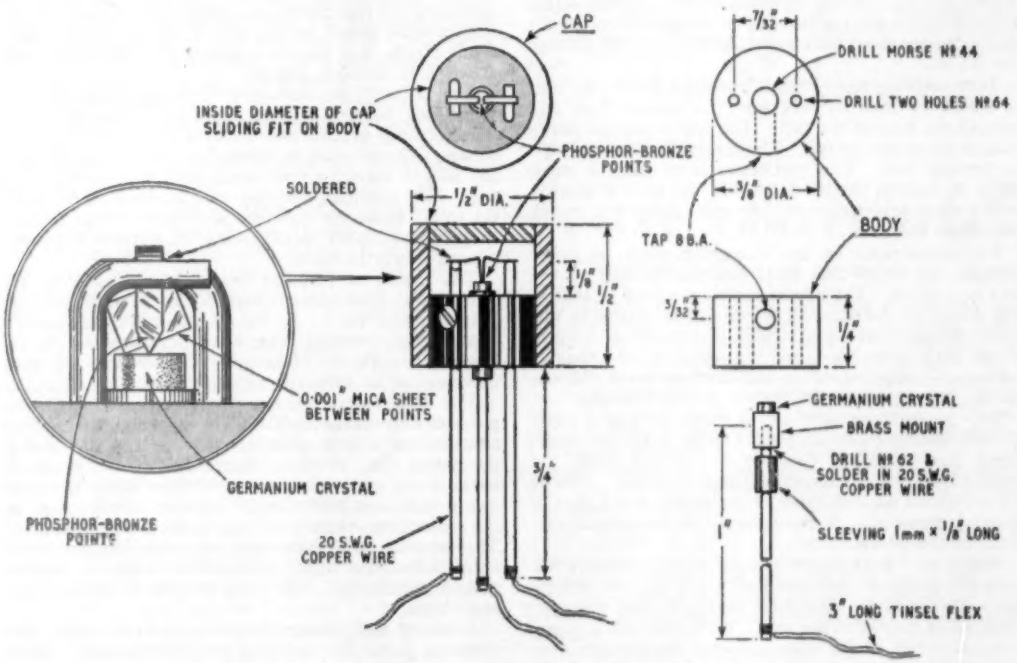


Fig. 1. Constructional details of home-made transistor.

in line with the first whisker. The points should be in contact together in the $\frac{1}{64}$in hole. Solder as for the first whisker. Remove the jig from the body and cut the spare ends of the whiskers close to the support wires. Trim with a fine file any projections outside the circumference of the body.

The points examined under the microscope should be within about 0.002in of each other at the tips. The bends should be slightly farther apart. Looked at sideways the two Vs should appear coincident. If the points themselves are in contact it does not matter at this stage.

Cut a rectangle of 0.001in mica about $\frac{3}{64}$in × $\frac{1}{16}$in and carefully place it with tweezers between the whiskers. Friction will hold it in place. The mica should be positioned about 0.01in above the points.

The assembly of the crystal requires care. Insert the crystal on its mount into the central hole until the crystal comes into contact with the points. Increase the pressure until the top parts of the whiskers deflect about 0.01in. Tighten the grub screw. The insulated sleeving should also be inside the central hole as far as it will go. This is to give mechanical stability.

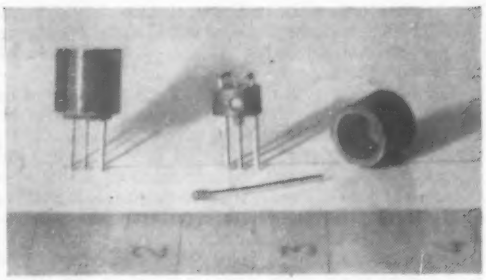
Examine the point spacing under the microscope. Any spacing between 0.0005in and 0.005in will make a transistor, but 0.002in is about optimum. If the points are found to be touching each other, release and partially withdraw the crystal and move the mica spacer down nearer the points. Readjust the crystal-point pressure as before. If the points skate about on the surface of the crystal it means that the angle at which the points meet the surface is incorrect. The angle must be as near normal as possible. Any latent instability of the points can be discovered by smartly tapping the body. The tapping procedure also helps to settle the points into the etched surface of the crystal. After tapping re-examine the point spacing. If satisfactory the cap should be fitted to protect the unit. Do not push the cap on too far or it will damage the points.

After forming and testing (described below) the unit is sealed by melting wax into the central hole and around the base of the cap. The wax must not penetrate as far as the crystal. The insulated sleeving helps to prevent this. The procedure is to place a small pellet of wax on the inverted unit and melt it quickly with a clean soldering iron. As soon as the wax melts, withdraw the iron.

All connections to the transistor must be made through the tinsel flex leads and not directly to the 20 s.w.g. wires. The reason is that the heat of soldering direct to the support wires would probably unsolder the internal joints. Also, if connection is made direct with crocodile clips, the shock of the spring-loaded clip slipping off is sufficient to break the cohesion developed at the points during forming.

The preliminary tests are to establish that a satisfactory double-diode exists. Check with the ohmmeter the resistance between the points, with the crystal lead (base connection) left floating. This is the unformed emitter-collector resistance and is usually about 1 megohm. A short-circuit requires readjustment of the points.

When the "Avometer" is used as an ohmmeter the normally positive (red) terminal has a negative potential. This will be described as the virtual negative terminal in the following text. With the virtual negative connected to the base, measure the resistance to each point. Each should be less than 1,000 ohms. Typical value is 500 ohms. Repeat with the virtual positive to the base. Each should be greater than 100,000 ohms. Typical value is 1 megohm. These readings should be fairly stable. If there is severe jitter the point pressure should be increased. The final forming process usually removes the last trace of jitter.



Appearance of finished transistor, with and without sealing cap.

The next test is for transistor action. Connect the ohmmeter between one point and the base, with the virtual negative to this point (collector). Between the other point (emitter) and base, connect the 4½-volt battery in series with the 4,700-ohm resistor, making the emitter positive. The indicated collector-base resistance should fall about ten times, when the emitter bias is applied. Any observable drop in resistance is encouraging. If the drop is large, suspect an emitter-collector short-circuit. Repeat with the points interchanged. Choose the arrangement that gives the largest percentage drop in indicated resistance. Mark the collector wire with a spot of paint. If no transistor action can be detected, try a new spot on the crystal or change the crystal. Very few crystals tested by the author failed to give transistor action, and excellent results were obtained with about half of those tested.

The collector point must now be electrically formed to get the current gain (alpha) up to a useful value. The forming process also reduces the collector impedance. The increase in alpha, however, far outweighs the loss in collector impedance with successful forming. For example, forming can increase alpha from 0.1 to 2.5 while the collector impedance drops from 1 megohm to 25,000 ohms, giving an increase in power gain of nearly 16 times.

The theory of forming has been discussed by W. Shockley[3], J. Bardeen[4] and W. H. Brattain, W. G. Pfann[3,4], also by L. B. Valdes[5] and W. R. Sittner[6]. Methods of forming have been described by B. N. Slade[8] and R. W. Haegele[7]. The essence of these theories can be summarized as follows:—

The collector is formed by passing a short heavy pulse of current through it. The intense local heating changes the *n*-type germanium to *p*-type just under the point. In addition, thermal diffusion transfers some of the point material or surface impurities into this *p*-type area and changes an even smaller area in the immediate vicinity of the point back to *n*-type. The result is as if there were an *n-p-n* junction transistor with base input connection acting in cascade with the collector. The current gain is correspondingly high.

A theory that thermal traps are formed under the collector point also accounts for the very high alpha sometimes observed at low emitter currents. "Holes" caught in these traps form a positive space charge

which attracts electrons from the collector. The average velocity of the electrons is much greater than that of the trapped "holes," consequently the current gain is that much greater. In practice the traps become saturated for emitter currents much above 50 μA. Consequently, the alpha falls to normal values of 2 or 3 at the more usual emitter current levels of 1 mA or so. In addition, this peak of alpha is very sensitive to temperature. This high alpha at low emitter current is not of much interest in transistors used as high-level amplifiers, but it is very important in the case of switching transistors. It greatly affects the triggering sensitivity in some switching circuits.

The purely thermal conversion to *p*-type material under the point can probably be provided by any short pulse, unidirectional or oscillatory; but better results are obtained when the collector is pulsed negatively, with suitable precautions to prevent the pulse becoming oscillatory. There is considerable scope for experiment in methods of forming.

A typical method of forming, given by B. N. Slade, is to discharge a capacitor of from 0.001 to 0.1 μF between the collector and base. The capacitor should have been previously charged to a voltage of from -75 to -300 volts. A charge/discharge switch is convenient. The emitter bias may be left connected, but the ohmmeter must be disconnected from the collector. Auxiliary contacts on the charge/discharge switch can do this.

Start pulsing at low voltage (80 volts) using the smallest capacitor. After each pulse measure the collector resistance (as before) with and without emitter bias. Increase the pulse in 20-volt steps and increase the capacitor at the end of each voltage cycle. Stop pulsing when the collector resistance, with emitter bias, has fallen to below 1,500 ohms, or when the collector resistance for zero bias has fallen below 10,000 ohms. A good transistor will be greater than 30,000 ohms for zero bias and less than 1,000 ohms with bias. When satisfactory results are obtained seal the unit with wax as described above.

More elaborate tests of the characteristics can be made point-by-point with suitable meters and current supplies.

The following tentative ratings are recommended for the home-made unit:—

Maximum collector voltage (d.c.)	-30 volts.
Maximum collector voltage (peak)	-80 volts.
Maximum collector current (d.c.)	-10 mA.
Maximum collector dissipation ..	50 mW.

These figures can, of course, be modified as experience is gained.

The application of the transistor in circuits requires care if a reasonable life is to be obtained. Inductive and capacitive surges are particularly to be avoided. Switching off a transistor circuit containing a transformer, for example, can easily produce an inductive kick which will "over-form" the collector, with disastrous results. In such circuits it is advisable to replace the usual on-off switch by a potentiometer plus switch, so that the current is slowly reduced to a low value before switching off. In circuits where the transistor is used to discharge a capacitor it is advisable to include a 1,000-ohm resistor in the collector lead to limit the peak current to a safe value. Oscillatory circuits which are liable to "squegg" are dangerous. For this reason one should not lightly attempt to obtain Class C operation by means of a C.R autobias network in the emitter circuit.

Home-made transistors have been applied to several different circuits, such as a saw-tooth generator, a sine-wave audio oscillator, an e.h.t. generator, a bistable multivibrator, a medium-wave straight receiver and an audio amplifier. The e.h.t. generator provides 860 volts d.c. for an input to the transistor oscillator of 2.2 mA at 16 volts. It forms part of a megohmmeter which measures up to 20,000 MΩ, and is contained in a box (complete with a hearing-aid type battery) measuring 6in $\times$ 4in $\times$ 3in.

The e.h.t. supply has also been used in conjunction with an image-convertor tube, and could be used to supply a small cathode-ray tube for oscillographic work.

The medium-wave receiver was, in fact, a crystal set (germanium diode) with one transistor stage of h.f. amplification, and used a loop aerial. A rough measurement of power gain gave a figure of 26 db. Part of this gain was due to positive feedback (reaction), but the circuit was quite as tame as any similar valve circuit. If one allows for the square law of the detector the effective gain was 52 db!

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[8] B. N. Slade, "Factors in the Design of Point-contact Transistors," *R.C.A. Rev.*, Vol. 14, No. 1; March 1953.

ESSAY COMPETITION

Scientific Research in Industry

PRIZES of £100 and £50 are being awarded for the best and second-best entries in an essay competition which is being run by the journal *Research*. The essay has to be about any recent scientific discovery and its applications in industry, or any item of industrial research work that the competitor thinks should be undertaken. Entries have to be about 3,500 words long and must be written without technical jargon so that they can be understood by a board of directors or management committee with no specialist knowledge. Competitors must be able to prove that they are engaged on scientific research, and their essays have to be sent in by 30th June, 1954.

In addition to the ordinary prizes, two special ones of £100 and £50 are to be awarded by the *Sunday Times* for entries which are suitable for publication in a general newspaper and which relate to one of the following subjects: applications of atomic energy; aerodynamics; conservation or utilization of fuel; electronics in business efficiency.

Further details can be obtained from the publishers of *Research*, Butterworths Scientific Publications, 88 Kingsway, London, W.C.2.

Band 4 Television Converter

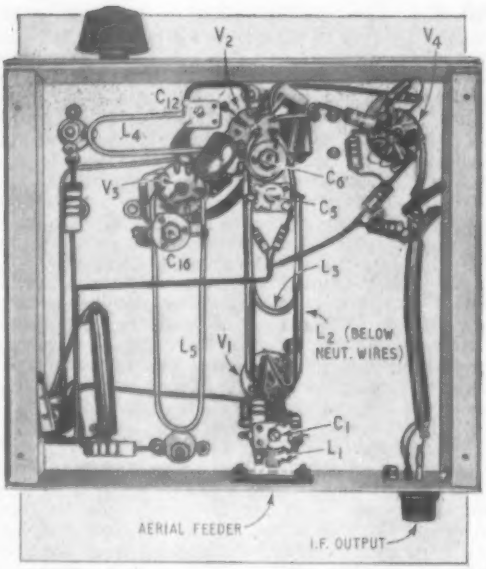
IN view of recent speculation on the use of Band 4 (470-585 Mc/s) for television, considerable interest has been focused on the experimental transmissions arranged by the Television Society. These will take place in the 70-cm amateur band with the vision on 427 Mc/s and the sound on 423.5 Mc/s.

If reasonable care is exercised a small converter using normal valves and established circuit technique can be employed at frequencies of this order. An example of this is a converter designed especially for receiving these experimental transmissions which was described by D. N. Corfield in the *Journal of the Television Society* for January-March, 1953. An orthodox power unit is used giving 250 V, 75 mA h.t. and 6.3 V, 1.2 A l.t. The oscillator (V_3) h.t. supply is stabilized by a Brimar VR150/30 voltage stabilizer, or its equivalent, at 150 V.

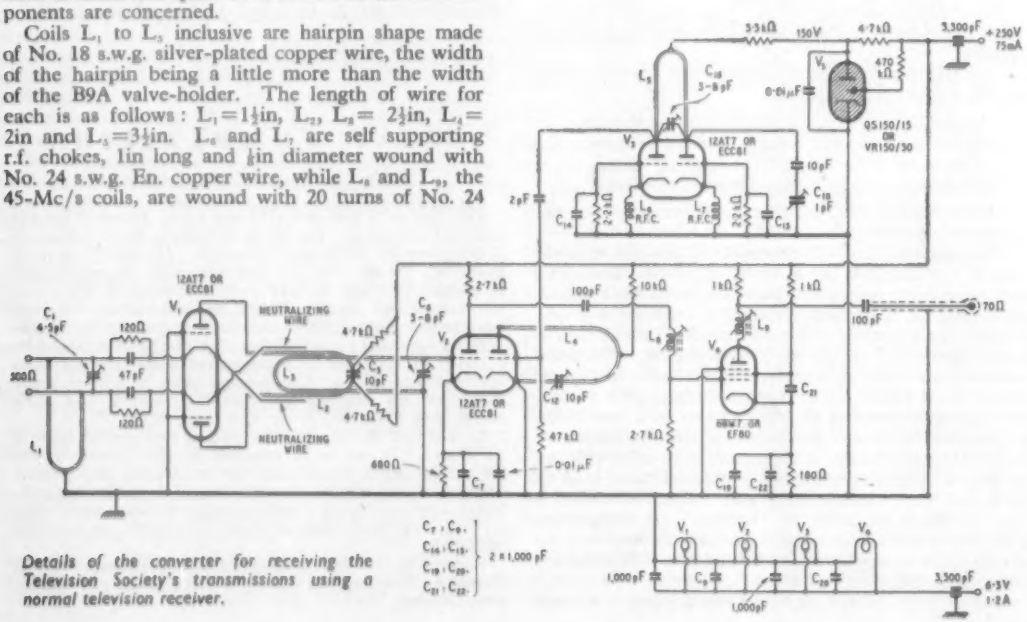
The converter is intended for use with a normal television receiver tuned to the London station (45 Mc/s). V_1 is a double triode (12AT7) employed as an earthed grid push-pull r.f. amplifier and is neutralized as shown. The left-hand section of V_2 (12AT7) is an anode-bend triode mixer and the right-hand section a frequency-doubler for the variable oscillator V_3 (12AT7) operating on 190 Mc/s. The internal coupling in V_2 suffices for mixing purposes, no other coupling being needed.

V_4 is an i.f. amplifier at 45 Mc/s using a 6BW7 or EF80 valve. Its grid and anode circuits are a little unusual but quite orthodox in so far as components are concerned.

Coils L_1 to L_5 inclusive are hairpin shape made of No. 18 s.w.g. silver-plated copper wire, the width of the hairpin being a little more than the width of the B9A valve-holder. The length of wire for each is as follows: $L_1 = 1\frac{1}{2}$in, L_2, $L_3 = 2\frac{1}{2}$in, $L_4 = 2$in and $L_5 = 3\frac{1}{2}$in. L_6 and L_7 are self supporting r.f. chokes, 1in long and $\frac{1}{8}$in diameter wound with No. 24 s.w.g. En. copper wire, while L_8 and L_9, the 45-Mc/s coils, are wound with 20 turns of No. 24 s.w.g. En. copper wire on Aladdin No. PP5938 formers with dust cores and enclosed in Dale Type D/TV2 aluminium cans. It is essential that the receiver used with this converter does not pick up an unreasonable amount of 45-Mc/s signal with its aerial disconnected.



Underside of the converter showing layout of the parts. The principal components can be identified by the aid of the circuit references.



Details of the converter for receiving the Television Society's transmissions using a normal television receiver.

WORLD OF WIRELESS

Ionospheric Cross-modulation • Television Show • Mobile Radio Users • Amateur Emergency Network

"*Luxembourg Effect*" *Again*

LITTLE has been heard of the Luxembourg Effect* for some years, probably because of the general increase of power of medium-wave stations and of the tendency of listeners to avoid medium-wave reception by indirect-ray, since very few transmissions can now be received with anything approaching "programme-value" beyond the ground-ray range. However, since a very high-power transmitter radiating the "Voice of America" programmes on 173 kc/s opened near Munich, reports have been received from many parts of Europe that its modulation has been heard superimposed on medium-wave programmes.

The European Broadcasting Union is investigating the reports as it is thought that they may throw some light on the subject of cross-modulation and the Union would welcome reports from *Wireless World* readers who may observe the effect. The factors which influence the phenomenon include the range and bearing of the desired and interfering stations from the receiving point. Correspondents should also state the date, time and place of the observation, the name and frequency of the desired station, and give as full a description as possible of the severity and nature of the cross-modulation. Reports should be addressed to the Centre Technique, Union Européenne de Radiodiffusion, 32, Avenue Albert-Lancaster, Bruxelles-Uccle, Belgium.

* The superimposition of the modulation of a long-wave station on that of a medium-wave transmitter when the path of the m.w. station passes through a region of the ionosphere disturbed by the l.w. transmissions.

Isle of Man TV

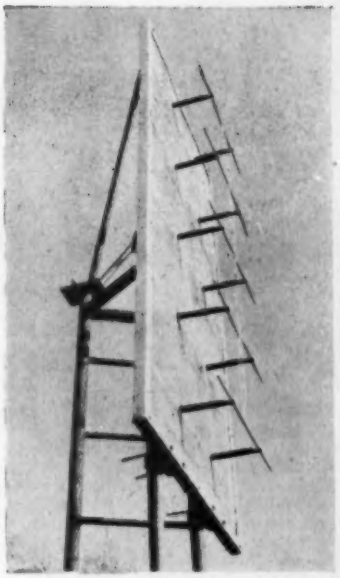
ANOTHER temporary low-power television station, installed near Douglas, Isle of Man, was brought into service by the B.B.C. on December 20th. Operating in Channel 5 (vision 66.75 Mc/s, sound 63.25 Mc/s), which it shares with Wenvoe and Pontop Pike, the transmitter employs the asymmetric side-band method of transmission with vertical polarization. The permanent station, for which a site has not yet been found, will operate on the same frequencies. The station will initially depend on the direct reception of Holme Moss for its programmes.

Radio Fuze Award

A TAX-FREE AWARD of £20,000 to Pye, Limited, for the development during the war of the proximity fuze and the No. 19 tank radio set has been made by the Government. The fuze, which was described in *Wireless World* of November, 1945, depended for its operation on an application of the Doppler effect. Radiation from a miniature transmitter, fitted inside an anti-aircraft shell, was reflected from the target and received back at a slightly different frequency. The beat note thus obtained was amplified and, on reaching a sufficient intensity, set off the fuze.

Television Show

NEARLY 40 EXHIBITORS are participating in the annual exhibition of the Television Society which opens at the Electrical Department of King's College, Strand, London, W.C.2, on January 7th. On the first day admission is restricted to members and the Press (6-9 p.m.). On subsequent days it will be open from 12 noon to 9.0 (8th) and 10.0-9.0 (9th) to holders of tickets obtainable from the Society at 164, Shaftesbury Avenue, W.C.2.



One of the two identical arrays for the Television Society's transmitter. Each array has 5 pairs of half-wave dipoles stacked in front of, and spaced a quarter wave length from, an expanded-metal reflector measuring 6ft × 3ft.

In addition to the following organizations, some individual members of the Society will be exhibiting equipment. Avo, B.B.C., B.I.C.C., B.R.E.M.A., Belling & Lee, Bush, Balcombe, Sydney S. Bird, Cinema-Television, E. K. Cole, Central Equipment, Direct TV Replacements, Dubilier, E.M.I. Engineering, E.M.I. Institutes, Ediswan, Ferguson, Ferranti, G.E.C., A. H. Hunt, Hallam Sleigh & Cheston, Leland Instruments, Livingston Hogg, Mole Richardson, Mullard, Murphy, Nera, Norwood T.C., P.O. Research Station, S.T.C., 20th Century Electronics, T.C.C., Telequipment, Telcon, Wayne Kerr.

During the exhibition it is planned to start up the Society's 405-line experimental transmitter working on 427 Mc/s, which is installed at the Norwood Technical College. The sound and vision aerial arrays, designed by D. N. Corfield, have been made by Belling & Lee and presented to the Society for the transmitter.

Purchase Tax Concession

IT has been decided by the Customs and Excise Office that "pillow-phones"—used by hospital patients unable to wear the conventional headphones—will not be liable to purchase tax, even if they incorporate cone-type loudspeaker chassis.

It is pointed out that the matter will be reviewed if a market for domestic use develops.

Mobile Radio

WHEN announcing the formation of the Mobile Radio Users Association, Sir Robert Renwick said that its aims are briefly to represent those who operate mobile radio—the generic term for "business radio" and the like—who with the advent of competitive television are likely to be compelled to change their frequencies.

The Association contends that the present uncertainty of frequency allocation is hampering the development of mobile radio. It demands that mobile users be allowed to maintain their present position in Band 3 unless some satisfactory alternative can be offered; any user displaced should be compensated and, furthermore, security of tenure in the new channel should be guaranteed.

The technical adviser to the Association is J. R. Brinkley of Pye Telecommunications. The head office of the M.R.U.A. is at 199, Piccadilly, London, W.1, but the secretary, Ronald Simms, is at Buckingham Court, Buckingham Gate, London. S.W.1 (Tel.: Abbey 5763).

Emergency Communications

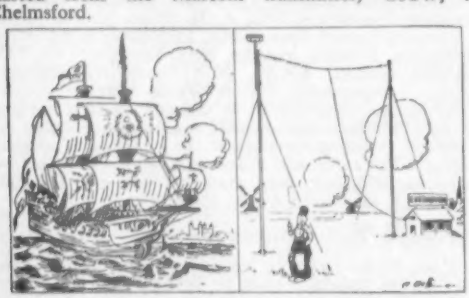
AN EMERGENCY SERVICE to provide communications in time of national disaster, such as the East Coast floods of last year, has been formed by the Radio Society of Great Britain. This Radio Amateur Emergency Network is open to all transmitting amateurs, who are asked to register their stations with the R.S.G.B. The Society envisages the formation of a nation-wide system of local networks operating in the 2-, 10- and 80-metre bands.

The new service will offer its facilities to such bodies as the Post Office, the Red Cross, W.V.S., hospital ambulance services, public utility undertakings, rescue services, the police and civil defence units. To maintain close liaison with these organizations a communications officer is to be appointed in all major cities and towns. The network will provide means of communication only when the normal Post Office telephone services are either out of commission or overloaded, and will feed its messages into the Post Office lines at the nearest suitable point.

Empire Broadcasting

WE ARE REMINDED by the celebrations of the 21st anniversary of the B.B.C. Overseas Service of the efforts made by *Wireless World* as far back as 1926 for the establishment of a short-wave overseas service and using this very title "Empire Broadcasting." It is interesting to recall that the idea was strongly criticized by Capt. P. P. Eckersley, then B.B.C. Chief Engineer, in a letter to *The Times*. He adopted the policy of "waiting for perfection" rather than introduce the experimental short-wave service for which we were pleading.

When the Dutch short-wave station PCJJ, at Eindhoven, was inaugurated early in 1927 (five years before the B.B.C. Empire station at Daventry started transmissions) we published the cartoon and caption reproduced below. Later that year experimental transmissions were started from the Marconi transmitter, G5SW, at Chelmsford.



"In 1652 Admiral Tromp, the courageous Dutch commander, defeated the British fleet under Admiral Blake at Dover, and, according to tradition, sailed up the Channel with a broom hoisted to his masthead to denote that he had 'swept the seas.' In 1927 the Dutch station of the Philips Company at Eindhoven 'sweeps the ether' on short waves and again scores off Britain, but this time in the friendliest spirit of rivalry."

PERSONALITIES

Norman C. Robertson, M.B.E., Assoc.I.E.E., M.Brit.I.R.E., has resumed his duties as deputy managing director of E. K. Cole, Ltd., having completed his two years' service with the Ministry of Supply as director-general of electronics production. While at the Ministry he was responsible for co-ordinating the production of electronic equipment for the defence programme. Mr. Robertson entered the radio industry in 1924 and joined Ekco in 1930, where he has been successively chief inspector, production manager, works manager and, since 1945, deputy managing director.

Peter E. M. Sharp, A.C.G.I., B.Sc., A.M.I.E.E., who, before joining the Telegraph Construction and Maintenance Co. in 1952, was for three years industrial officer (electronic equipment) with the Council of Industrial Design, is going to Malaya to join Telcon's agents in Singapore, the China Engineers, Ltd. Prior to joining the Council of Industrial Design, where he was responsible for the selection and organization of the communications and electronic exhibits for the Festival of Britain, he was with Standard Telephones and Cables.

Brigadier E. J. H. Moppett, M.I.E.E., has returned to this country after a tour of South America, the West Indies, U.S.A. and Canada on behalf of Pye Telecommunications, Ltd. He became a director of the company in 1952 on completing his tour of duty as Chief Inspector, Electrical and Mechanical Equipment, Ministry of Supply.

OUR AUTHORS

J. Moir, who contributes the article on stereophony in the cinema in this issue, is responsible for the design and development of sound reproducing equipment in the Electronic Engineering Department of the British Thomson-Houston Co., Rugby. He was co-author with C. A. Mason in 1940 of a paper to the Institution of Electrical Engineers which introduced pulse testing to the acoustic field. Mr. Moir has been responsible for the acoustic design of about one hundred cinemas and other buildings in Great Britain, including the Odeon Theatre, Leicester Square.

M. J. L. Pulling, M.A.(Cantab.), M.I.E.E., senior superintendent engineer of the B.B.C. Television Service, was among the members of the Corporation who, together with the Director-General, recently visited the United States to study television. He gives his impressions in an article on page 13. Mr. Pulling was at King's College, Cambridge, from 1925 to 1928, when he graduated as B.A. (Mechanical Sciences Tripos), after which he spent a year in the Cambridge University radio laboratory. Before joining the B.B.C. as assistant in the Engineering Information Department in 1934 he was for two years on the production testing of receivers at Murphy Radio. He was for nine years superintendent engineer (Sound Recording Department) before assuming his present position in 1949.

B. R. Bettridge, who describes an experimental transistor receiver on page 2, has been in the Osram Valve and Electronics Department of the General Electric Co. since 1950, working on semi-conductors. He joined the G.E.C. valve and c.r.t. works at Shaw, Lancs, during the war and was for a time after the war in the company's Process Heating Department in London, where he was concerned with r.f. heating. Before joining the G.E.C. he was with Ultra and the Marconiphone Co.

P. B. Helsdon, author of the article "Home-made Transistors," is employed as an engineer on the development of television camera equipment at Marconi's, Chelmsford, which he joined on leaving school in 1936. After his apprenticeship he worked in the Company's Test Department and in 1948 was transferred to the Development Division. His work on transistors is purely as a spare-time hobby.

Mr. H. N. Potok, contributor of the article on valve codes, graduated as B.Sc. (Electrical Engineering) at Glasgow University in 1941 and for the past two or three years has been a lecturer in electronics at the Royal Technical College, Glasgow. In the intervening years he was for some time with Partridge and Wilson, Leicester, on the development and design of rectifying equipment, in R.E.M.E. from 1944 to 1947 and was at Mullard's Valve Works, Mitcham, as development engineer in the Sub-Miniature Valve Department from his demobilization until he went to Glasgow in 1951.

IN BRIEF

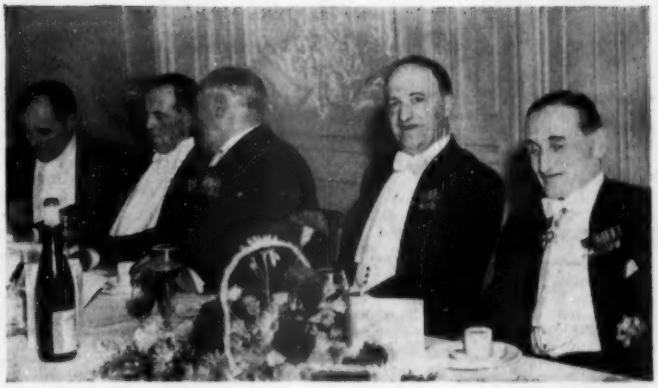
Q.R.P.—In order to give notification that a television station is operating with reduced power, the B.B.C. has introduced identification signals for both sound and vision which will be used during the trade test transmissions or during B.B.C. tests outside broadcasting hours. The identification signal for vision consists of 50-c/s or 100-c/s frame bars and for sound 250-c/s tone at 40 per cent modulation. When required the signals will be radiated for one minute out of every five during the transmissions.

G3AAT/OX, the radio station of the British North Greenland Expedition, of which Lt. Cdr. Brett Knowles is signal officer, has been received on 14 Mc/s by J. S. Bell, GM3WO, of Falkirk, Stirlingshire.

Eiffel Tower.—Recording the 50th anniversary of the opening of the wireless station in the Eiffel Tower, a French correspondent claims that but for radio this Parisian landmark would long ago have disappeared. The first station was installed for the army in 1903 by General Ferrié. The tower now supports the Paris television aerials.

A series of 11 lectures on **"Powder Metallurgy"** will be given at 7.0 on Tuesdays, commencing January 12th, at the Battersea Polytechnic, Battersea Park Road, London, S.W.11, for which the fee is 25s.

Anglo-German Trade.—Television apparatus figures among the exports to Germany allowed under the bilateral trade agreement concluded in December.



AT THE TOP TABLE at the Radio Industry Council Dinner on November 18th are (reading from the right) the president, Lord Burghley; the principal guest, the Rt. Hon. R. A. Butler; G. Darnley Smith (R.I.C. chairman); the Postmaster General (Lord De La Warr); and P. H. Spagnoletti (chairman of B.R.E.M.A.)

Colour Television. — The Fleming Memorial Lectures of the Television Society by G. G. Gouriet on "Colour Television" will be given at 7.0 on February 10th and 24th (not 12th and 25th as previously announced) at the Royal Institution, Albemarle Street, London, W.1. A limited number of tickets for non-members, costing 5s for the two lectures, are obtainable from the Society at 164, Shaftesbury Avenue, London, W.C.2.

Manchester Electronics Show.—The ninth annual electronics exhibition organized by the North-Western Branch of the Institution of Electronics will be held at the College of Technology, Manchester, from July 14th to 20th. It will include a scientific and industrial research section and a commercial section in which manufacturers will be participating. A programme of lectures is also being arranged.

A new trophy, to be known as the **Calcutta Key,** has been presented to the Radio Society of Great Britain by a past president, W. A. Scarr, who is at present in Calcutta as representative of the British Council. The trophy is to be presented annually to the member who, during the year, has "given the most outstanding service to the cause of international friendship through the medium of amateur radio." The first recipient is A. O. Milne, G2MI, the Society's new president.

Illegal Recording.—In the Blackpool Magistrates Court on December 4th, Jack Michaels, of Jack Michaels' Mobile Recording Studios, pleaded guilty to charges of having recorded illegally a broadcast performance and also to having sold records so produced. Fines totalling £8 were imposed. Under the Dramatic and Musical Performers' Protection Act, 1925, it is an offence to record directly or "indirectly" (e.g., through broadcasting) or to sell, hire or use *for public performance* any recording made without authority.

"**Electronic Aids to Production**" is the revised title of the Convention being organized by the British Institution of Radio Engineers to be held at Christ Church, Oxford, from July 9th to 12th.

Technical Writing.—The preparation of reports, collection of data and practical advice on the submission of papers for publication will be covered by Geoffrey Parr in a course of six lectures on the writing of technical reports he is giving at the Borough Polytechnic, London, S.E.1, on Thursdays at 6.30 p.m. commencing on January 21st. The fee is 15s.

Technical Publications Association.—An attempt is being made to form an organization which will aim at improving the standard of production of technical handbooks and obtaining a recognized status for people engaged in this type of work. Lectures and discussions are being planned and it is proposed to establish a formal system of graded membership. Further details can be obtained from C. E. Cunliffe, 33, Great North Way, Hendon, London, N.W.4.

Scottish Home Service Transmitter.—A new 2-kilowatt station at Mousewald, near Dumfries, replacing the temporary transmitter which has been in use in the area for some time, was brought into service by the B.B.C. on December 13th. It operates on 809 kc/s (370.8 metres).

Industrial Directory.—Among the seven main sections of the 26th edition of the "F.B.I. Register of British Manufacturers, 1954," is a buyer's guide classifying over 6,500 member firms of the Federation of British Industries under some 5,000 alphabetical trade headings. Other sections of this 952-page directory, which is produced by Kelly's Directories and our Publishers (price 42s), give information about trade association, proprietary names, trade marks, etc.

"**The Year that Made the Day**" is the strange title of an excellently produced book published by the B.B.C. giving a well-illustrated description of how the Coronation Day broadcasts were planned and carried through. As an appendix to this 80-page book a selection of 36 photographs taken from the screen of a television receiver on June 2nd is given. It costs 6s.

1955 Plastics Exhibition.—The third biennial British Plastics Exhibition and Convention is to be held at Olympia, London, from June 1st to 11th, 1955. Both the exhibition and convention are being organized as previously by *British Plastics*.

NEWS FROM ABROAD

Canadian Audio.—During his visit to New York for the Audio Fair in October, G. A. Briggs, of Wharfedale Wireless, crossed into Canada and addressed a joint meeting of the Acoustical Institute and the Toronto Chapter of the Society of Music Enthusiasts. At a subsequent meeting of the S.M.E., F. A. Towler, Tannoy's Canadian representative, demonstrated the Tannoy dual concentric speaker using a Williamson amplifier. P. G. A. H. Voigt, from whom we received this news, recently lectured to the Wireless Association of Ontario using the Voigt pre-war corner horn and a Williamson amplifier.

International Exchange of Manufacturing Rights.—The recently formed Porter International Company of 1025 Connecticut Avenue N.W., Washington 6, D.C., is interested in sponsoring in the United States the manufacture or use of British products or processes in various fields, including electronics. The company also arranges for the licensing of foreign manufacture of American products.

U.S. Magnetic Recording.—The growth of magnetic recording in America—"now a $100 million industry"—is evidenced by the formation of the Magnetic Recording Industry Association and the publication of a new bi-monthly journal *Tape and Film Recording* devoted to all aspects of magnetic recording.

International Congress on Sound Recording.—It has been decided to hold a public exhibition of equipment to run concurrently with this Congress, which, as announced in last October's issue, will be held from April 5th to 10th, in Paris. The organizers are the Société des Radioélectriciens, 10, Avenue Pierre Larousse, Malakoff (Seine).

INDUSTRIAL NEWS

"**Tape Deck.**"—We are informed by Truvox, Ltd., that the Patent Office has advised them of the cancellation from the Register of Trade Marks of the name "Tape Deck" registered by Wright and Weaire.

New Magnetic Tape.—Special equipment has been developed by the M.S.S. Recording Company at their laboratories at Hythe End, Bucks, for the production of high-grade, medium-coercivity tape suitable for 3¾ and 7½ in/sec speeds. The work has been carried out in conjunction with B.I. Callender's Cables and special attention has been given to the production of surface finish which will reduce wear of the magnetic heads to a minimum. The price of the new tape (Type AM15) is 37s 6d per 1,200-ft spool.

Exporting Magnetic Recorders.—A £30,000 order for 32 E.M.I. tape recorders and a large quantity of recording tape has been placed with the E.M.I. subsidiary company in the Argentine by the Argentinian Ministry of Communications. The equipment will be used by the country's broadcasting authorities.

Canadian Market.—John W. McCaslin, Jr., of 1021 Second Avenue N.W., Moose Jaw, Saskatchewan, would like to hear from manufacturers of radio and electronic equipment interested in the distribution of their products in Saskatchewan, Western Canada.

Presidential Radio.—A modified H.M.V. export receiver (Model 5321) covering 10 wavebands has been supplied by E.M.I. Sales and Service to the Indian Railways for installation in the new presidential coach. The order was received through Racal, Ltd. radio and aeronautical consultants of Kingsway, London.

Sonar (SOund NAvigation and Ranging), the American device employing supersonic radiations for underwater navigation, has been produced in this country by R.C.A. Photophone, Ltd., under the U.S. off-shore procurement programme. The first delivery of equipment was made to the Norwegian navy.

"C.R.T. Insurance."—Apropos of our note in the December issue on television maintenance insurance schemes, Whizards, Ltd., of Baker Street, London, W.1, have notified us that they have had such a scheme in operation since September, 1948.

Compact Portables.—A range of remarkably compact battery-mains portables, made by the German firm of Akkord-Radio, is available to retailers and selected wholesalers in this country through G-A Distributors, 29 Whitehall, London, S.W.1. There are three models, each fitted with internal ferrite-rod aerials, and British valves. A supply of spare parts will be available.

Coming of Age.—Two well-known radio companies have recently celebrated their 21st anniversaries: Roberts Radio of East Molesey, Surrey, who throughout the 21 years have concentrated on the production of portable receivers, and Aerialite of Stalybridge, Cheshire, specialists in cables and aerials. Aerialite has allocated £10,000 as a birthday bonus to the staff.

Decca Radar is now installed in, or ordered for, over 3,000 vessels—from ocean-going liners to police launches—throughout the world. In addition to the merchant ships of many nationalities nineteen of the world's navies use Decca radar.

Three new P. & O. cargo vessels—Patonga, Ballarat and Bendigo—are to be equipped with **Marconi Marine** radio communication and navigation gear.

NEW ADDRESSES

W. Edwards & Co. (London), Ltd., specialists in high vacuum techniques, have moved to new premises at Manor Royal, Crawley, Sussex. (Tel.: Crawley 1500.) The new factory covers an area of approximately 100,000 square feet.

The offices, stores and despatch departments of **Osmor Radio Products, Ltd.,** have been moved from Bridge View Works, Borough Hill, Croydon (which is being retained as a factory), to 418, Brighton Road, South Croydon, Surrey. (Tel. Croydon 5148-9).

Hifi, Ltd., of Stourbridge, Worcs, have moved to Derry Works, Derry Street, Brierley Hill, Staffs. (Tel.: Brierley Hill 7604.)

MEETINGS

Institution of Electrical Engineers

Radio Section.—"A Single-Sideband Controlled-Carrier System for Aircraft Communication" by G. W. Barnes, B.Sc., on January 13th.

Discussion on "Should Sound Broadcasting of the Future be Entirely in the V.H.F. Band?" Opener A. J. Biggs, Ph.D., B.Sc., on January 25th.

Both the above meetings will be held at 5.30 at Savoy Place, London, W.C.2.

East Midland Centre.—"Technical Colleges and Education for the Electrical Industry" by H. L. Haslegrave, M.A., Ph.D., M.Sc.(Eng.), at 6.30 on January 19th at Loughborough College.

North-Eastern Radio and Measurements Group.—Discussion on "Will Transistors Oust Receiving Valves?" Opener E. H. Cooke-Yarborough, at 6.15 on January 18th at King's College, Newcastle-upon-Tyne.

Sheffield Sub-Centre.—"Colour Television" by L. C. Jesty, B.Sc., at 6.30 on January 20th at the Grand Hotel, Sheffield.

North-Western Radio Group.—"A Simple Connection between Closed-Loop Transient Response and Open-Loop Frequency Response" by J. C. West, Ph.D., B.Sc., and J. Potts, B.Sc., at 6.30 on January 6th at the Engineers' Club, Albert Square, Manchester.

North Lancashire Sub-Centre.—"The History of Television" by G. R. M. Garratt, M.A., and A. H. Mumford, O.B.E., B.Sc., at 7.15 on January 13th at the N.W. Electricity Board Demonstration Theatre, Darwen Street, Blackburn.

South Midland Centre.—"Transmission of Pictures by Radio" by A. W. Cole at 7.15 on January 14th at the Winter Gardens Restaurant, Malvern.

South Midland Radio Group.—"A Method for the Synthesis of Speech" by W. Lawrence, M.A., at 6.0 on January 25th at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Southern Centre.—"Electronic Speed Control of Motors" by J. C. Rankin at 7.30 on January 13th at the R.A.E. Technical College, Farnborough.

"Radar Echoes from the Moon and Aurora" by I. A. Gatenby, M.Sc., at 6.30 on January 22nd at the South Dorset Technical College, Weymouth.

South-Western Sub-Centre.—"Electronic Telephone Exchanges" by T. H. Flowers, M.B.E., B.Sc., at 3.0 on January 27th at the Electric Hall, Torquay.

Reading District.—"Training in Electronic Fire Control in R.E.M.E." by Capt. R. A. Middleton, R.E.M.E., at 7.15 on January 25th at the George Hotel, Reading.

London Students' Section.—Film evening at 7.0 on January 11th at Savoy Place, London, W.C.2.

British Institution of Radio Engineers

London Section.—"Engineering Design of V.H.F. Multi-Channel Telephone Equipment" by W. T. Brown (British Telecommunications Research) at 6.30 on January 6th at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

Scottish Section.—"Radio Astronomy" by H. Seddon (Edinburgh University) at 7.0 on January 7th in the Department of Natural Philosophy, The University, Edinburgh.

Programme of technical films at 7.0 on January 20th in the Department of Natural Philosophy, The University, Edinburgh, and at 7.0 on January 21st at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2.

North-Western Section.—"The Manchester University Computer" by D. B. G. Edwards (Manchester University) at 7.0 on January 7th at the College of Technology, Manchester.

Merseyside Section.—"Interlacing Problems in Television Receivers" by Dr. G. N. Patchett, B.Sc. (Bradford Technical College), at 7.0 on January 7th at the Electricity Service Centre, Whitechapel, Liverpool, 1.

North-Eastern Section.—Short papers by students at 6.0 on January 13th at the Neville Hall, Westgate Road, Newcastle-upon-Tyne.

West Midlands Section.—"Microwave Measuring Instruments" by P. M. Ratcliffe (Marconi Instruments) at 7.15 on January 26th at the Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

British Sound Recording Association

London.—"The Violin: its Tonal Variations and Peculiarities" by D. J. W. Seagrove at 7.0 on January 15th at the Royal Society of Arts, John Adam Street, London, W.C.2.

Manchester Centre.—"The Problems of Hearing" by J. E. J. John (Manchester University) at 7.30 on January 18th at the Engineers' Club, Albert Square, Manchester.

Television Society

London.—"The Marconi Television O.B. Unit" by K. E. Owens and P. R. Berkeley at 6.45 on January 6th at Film House, Wardour Street, London, W.1. (Joint meeting with the British Kinematograph Society.)

"American Television" by J. Sieger at 7.0 on January 21st at the Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, London, W.C.2.

Institute of Practical Radio Engineers

Berks, Bucks and Oxon Section.—"Television Service" by J. Barton (English Electric) at 7.30 on January 13th at the White Hart Hotel, Reading, Berks.

Society of Instrument Technology

Birmingham.—"Supervisory Control and Telemetering" by R. W. Field and E. Norton at 7.0 on January 8th at Regent House, St. Philip's Place, Colmore Row, Birmingham, 3.

Radio Society of Great Britain

"Art and Science in Sound Reproduction" by F. H. Brittain, D.F.H. (G.E.C. Research Laboratories), at 6.30 on January 29th at the I.E.E., Savoy Place, London, W.C.2.

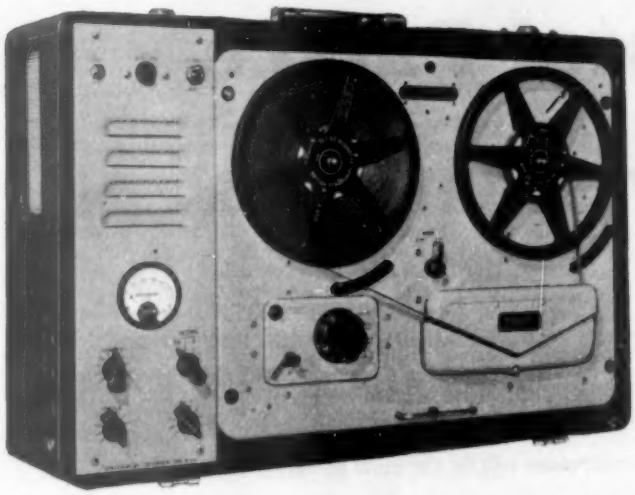
Institute of Navigation

"Methods of Air and Surface Navigation" by Wing Commander E. W. Anderson, D. H. Sadler, Lt. Commander R. B. Michell, R.N., and Group Capt. E. Fennessy at 5.0 on January 15th at the Royal Geographical Society, 1, Kensington Gore, London, S.W.7.

Institution of Production Engineers

Yorkshire.—"Electronics as an Aid to Productivity" by R. McKennell at 7.0 on January 11th at the Hotel Metropole, Leeds.

VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures 8½in. x 22½in. x 15½in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ The noise level is extremely low and audibly the hum level and Johnson noise of the amplifier and deck are approximately equal. Only 25% of this small amount of hum is given by the amplifier alone.

★ Extremely low distortion and background noise, with a frequency response of 50 c/s.—10 Kc/s., plus or minus 1.5 db. A meter is fitted for the measurement of signal level and bias level.

★ Sufficient power is available for recording on disc, either direct or from the tape, without additional amplifiers.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ Facilities are provided for using the amplifier alone and using power output or headphones while recording or to drive additional amplifiers.

★ The unit may be left running on record or play back even with 1,750 ft. reels with the lid closed

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE £18 0 0.**

3-WAY MIXER AND PEAK PROGRAMME METER

FOR RECORDING AND LARGE SOUND INSTALLATIONS, ETC.

One milliwatt output on 600 ohm line (.775V) for an input of 30 micro-volts on 7.5-30 ohm balanced input.
Output balanced or unbalanced by internal switch. The meter reading is obtained by a valve voltmeter with 1 second time constant, which reads programme level, and responds to transient peaks.
Calibration in 2 db steps, to plus 12 db and minus 20 db referred to zero level. Special low field internal power pack supplies 8 valves including stabilising and selenium rectifier, consumption 23 watts.

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Telephones: LIBerty 2814 and 6242-3 Telegrams: "Vortexion, Wimble, London."

Crystal Palace Transmitters

Britain to have most powerful transmissions with Marconi-equipped station

By 1956 BBC television transmissions will be the most powerful in the world.

For the new Crystal Palace station which will replace Alexandra Palace, the Corporation has ordered Marconi sound and vision transmitters. They will be used with a high gain aerial system which will radiate 200/250kW—twice the power of existing Regional transmitters.

Two 15kW vision transmitters, the first two in the world to work in parallel, will ensure the highest reliability of service. They will use a new type of tetrode valve of small size, a Marconi development permitting valuable space savings in transmitter design. Two 4½kW sound transmitters will also operate in parallel.

Marconi high or medium power transmitters and high power aerials are installed in every one of the BBC's television transmitter stations, while Marconi television equipment has been ordered by countries in North and South America, Europe and Asia.

MARCONI

complete television transmitting equipment

MARCONI'S WIRELESS TELEGRAPH COMPANY LTD · CHELMSFORD · ESSEX

R.S.G.B. Exhibition

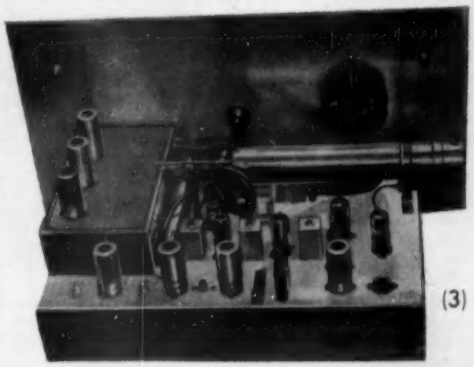
Equipment Shown by the Royal Corps of Signals, the R.A.F. and by Amateurs

THE announcement that the recent amateur radio exhibition was to be opened by Mr. Rene Klein, one of the founder members, calls to mind the fact that this event marked the 40th year of the Society's existence. Unfortunately, Mr. Klein was prevented by reasons of health from performing the opening ceremony and his place was taken by Brigadier Eric Cole, Chief Signals Officer, Southern Command.

The Royal Air Force showed a replica of a repair line assembly as used in the central repair depot for servicing v.h.f. aircraft sets. It showed the procedure from the initial inspection and recording of defects, through the repair stages to the final test and inspection. One could not fail to be impressed by the way in which a highly complicated 10-channel remotely-controlled transmitter-receiver is broken down into a few functional units with every component easily accessible for test and replacement. One corner of this stand was given over to the R.A.F. Amateur Radio Society, a wall-map showing the world-wide nature of the organization as most overseas stations have one or more members among their personnel. On view also were some examples of v.h.f. equipment constructed in their spare time by servicing members of the Society.

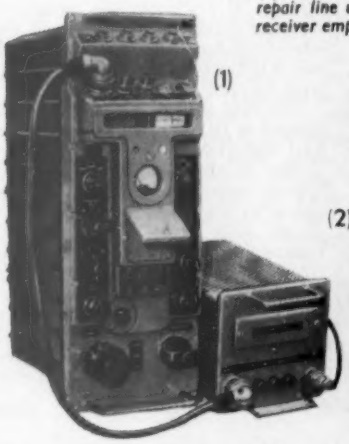
Some of the latest radio equipment in use, or about to be used, by the Army was shown by the Royal Corps of Signals. A new communications receiver, the GFR562, attracted much interest in view of its unusual design. The set is tall and narrow but of considerable depth and is housed in a sturdy, sealed case provided with forced air ventilation. The valves fit in sealed sockets in a narrow vertical channel at the back of the set. There are band-switched rotatable scales calibrated in frequency and an optical projection system for expanding each scale to about 120 in. It is a double superheterodyne and in six ranges covers 640 kc/s to 26 Mc/s.

Single-sideband operation of telephony transmitters is gaining popularity among the more advanced amateurs, as it has several advantages over the double-sideband system in very crowded wavebands. The bandwidth required for a station is very much less and less power can be used for the same signal strength at the receiving end, or alternatively a much larger effective signal output is obtainable from the transmitter for a given power input. Some simplification of equipment is possible as modulation is applied at a low level. The various exhibits in this section well exemplified the general reduction that can be effected in the size of a transmitter of a given power output, and elsewhere in the exhibition were



(3)

(1) New communications receiver, Type GFR562, shown by the Royal Corps of Signals. (2) Replica repair line used in the R.A.F. for servicing v.h.f. aircraft equipment. (3) Seventy-centimetre receiver employing linear circuits (plumbing).



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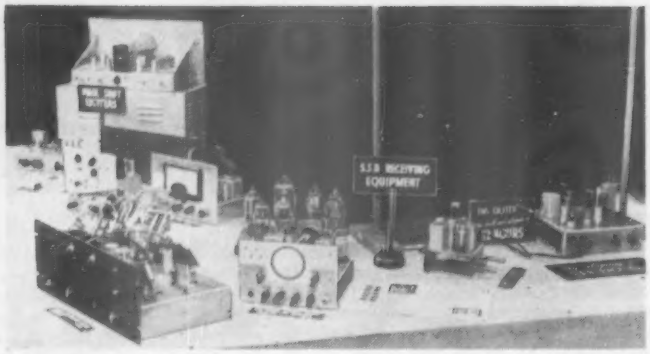


The "Reflectometer" standing-wave and aerial matching bridge, with one of the two probes in the foreground, and (right) corner of the stand devoted to amateur-built single-sideband equipment.

a number of orthodox type transmitters of comparable output for comparison.

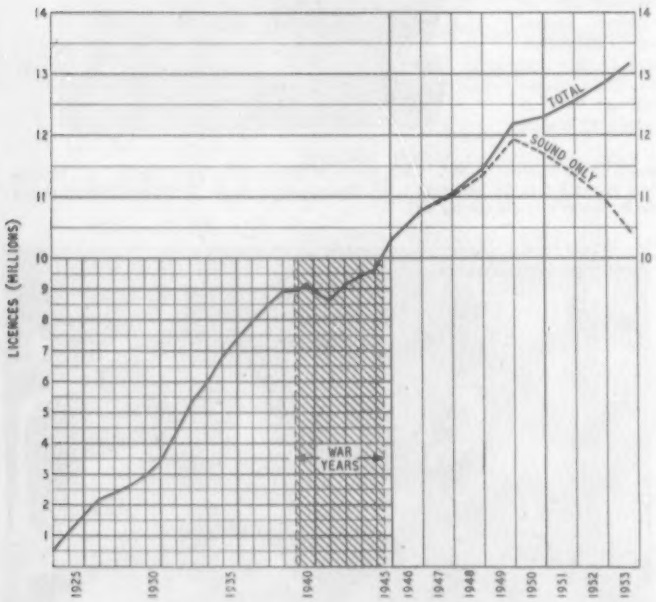
In the v.h.f. section the most interesting sets were those designed for use in the 70-cm band. "Plumbing" and orthodox circuitry sat side by side, but in general the former is used for reception and the latter for transmission.

Trial and error methods of doing things do not obtain in many amateur stations, if the wide variety of home constructed test and measuring equipment at the Show is any guide. These included precision frequency meters, valve-voltmeters, noise generators, grid-dip meters, oscilloscopes, field-strength and aerial impedance measuring sets. One of the last mentioned, described as the "Reflectometer," was particularly interesting as it employs bridge technique to balance the forward and reflected r.f. voltages on a short length of coaxial line, using two probes spaced a few inches apart. Each contained a crystal diode and the unit covered 144 to 420 Mc/s.

The British Amateur Television Club was well in evidence, but adopted a more static rôle than usual, no demonstrations being staged this year. Their activities have already been described at some length under the heading "Amateur Television Progress" in last month's *Wireless World*.

Some last-minute changes in the exhibit of Cosmocord resulted in the HGP40 pick-up (mentioned in our December issue) not being on view, but in its place was a new pick-up head of the same design, but for use with the GP20 pick-up arm. Separate heads are required for standard and long-playing records although there was an implication in our pre-view that the one head served for both purposes.

BROADCAST RECEIVING LICENCES



WITH broadcast receiving licences in Great Britain and Northern Ireland now well over thirteen million—the last available figure (October) was 13,153,314—it is interesting to see from this graph the steady growth in the number of licensed receivers from the beginning of 1924 to October 1953; that is, if we ignore the temporary decrease during the early part of the war—from August 1940, when the total was 9,153,380, until the end of 1941, when it had dropped to 8,625,580.

The peak in "sound" licences was reached at the end of 1949 when the total was 11,941,600. The continued growth in the number of television licences—now totalling 2,727,070—is shown by the divergence of the two curves since 1946 when separate licences were introduced. This section of the graph has been enlarged in order to show more clearly this divergence. The graph is plotted from figures supplied by the Post Office.

The number of licences for receivers installed in cars has now reached 200,286.

Compatible Colour Television

Views on the Sideband Interference Problem

By D. A. BELL,* M.A., B.Sc., Ph.D.

ON page 523 of the November, 1953, issue it is suggested that the American system of frequency interlacing sidebands is not foolproof, because the occurrence of ordinary picture sidebands of substantial intensity on the frequencies allocated to the colour sub-carrier and its sidebands would cause interference between black-and-white and colour signals; but I think the chief difficulties in applying the system in Britain lie in a different direction.

The interference from the monochrome sidebands to the colour signal would, in principle, cause false colour rendering, but it appears from the N.T.S.C. specification that the colour sub-carrier will, in fact, be at a considerably higher level than any probable monochrome sideband at this frequency. If an exceptional monochrome sideband is generated by putting on a pattern related to the well-known chequer-board, will anyone mind its having a gentle rainbow hue? In the reverse direction, interference from the colour sub-carrier to the black-and-white picture always exists, though partially concealed by the alternate-frame reversals. This interference will not interact with any steady pattern of the same frequency which may be present unless the non-linear response either of the eye or of some part of the television system prevents the two components from operating separately.

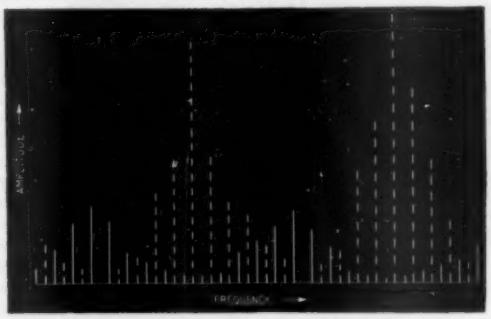


Fig. 1. Interlaced sidebands of the colour and monochrome signals in the N.T.S.C. colour television system. The full lines represent the monochrome sidebands and the broken lines the colour sidebands.

There is, however, a difference between the British and American monochrome systems in their probable abilities to eliminate the interference pattern due to the colour sub-carrier. First, we should be at a slight disadvantage relative to the U.S.A. because our 25-c/s picture frequency would show more residual flicker of the interference pattern than would occur with the American 30 c/s. More serious, however, is the fact that we endeavour to resolve a 3-Mc/s pattern with a system in which the nominal video band does not much exceed this frequency. The American video band, on the other hand, goes up to a full 4 Mc/s, but there is some evidence that the overall resolving power of typical receivers does not do justice to this band and a 3.5-Mc/s flicker pattern is not serious degradation. Neither would a 3.5-Mc/s pattern be serious to us—we usually stop at 3 Mc/s anyway—but to get the video sub-carrier of a frequency-interlace system adequately within the British video band would result in an interference pattern of the order of 2 Mc/s only, which would be far more serious than the 3.5-Mc/s pattern.

It seems that the American system does not, after all, get three pints into a pint pot, but only one and a half pints. (I am tempted to say one pint and some froth, but it is really a little better than this.) First of all, the physiology of the eye allows the bandwidths of the colour signals to be less than that of the luminance (brightness) signal, so that without any overlapping of sidebands one needs only twice the bandwidth of monochrome in order to transmit adequate three-colour pictures. Then by judicious interleaving one can compress the two channels into a little less than one and a half times the channel which has generally been effectively utilized hitherto.

I would also like to point out that the diagram of frequency-interlaced sidebands on page 526 of the November issue is very diagrammatic: there are actually more than 200 sidebands between adjacent harmonics of the line frequency, so that the decrease in amplitude as the frequency departs from a line harmonic is likely to be more gradual than is suggested by this diagram, which has been traditional since the 1934 paper of Mertz and Gray (*B.S.T.J.*, Vol. 13, p. 464). Also, each colour group is likely to be practically as wide as a monochrome group, the bandwith limitation on the colour affecting the number of groups (number of line harmonics) which are associated with the colour sub-carrier. Fig. 1 is probably a more realistic representation of the frequency-interlaced sidebands, though it still shows only a fraction of the real number between line harmonics, and no great significance can be attached to the relative amplitudes of the various components in the sketch. It will be noticed that the individual sidebands still interlace when the groups overlap. It appears to be implicit in the N.T.S.C. specification that all scanning frequencies are to be developed from the frequency of the colour sub-carrier, so as to ensure accuracy of interlace between the two groups of sidebands to this degree.

* University of Birmingham.

Long-Playing Magnetic Tape

Experimental Equipment for Speech, Using 48 Tracks per Inch

Each cassette gives a reading duration of 12 hours. There are 24 tracks on ½-in tape.

FOR many years the Royal National Institute for the Blind and St. Dunstan's have maintained a library of "talking books" recorded on 24-r.p.m. discs. Many of the books, which are recorded by experienced readers, run to 12 hours or more in duration, with an average of six to eight hours for popular short novels. The playing time of discs is 24½ minutes per side and 10 double-sided records, packed in a special fibre container, is the standard unit for transmission through the parcels post.

Against this background of established service, the research section of the Sound Recording Department is continuously exploring alternative methods of recording with the object of giving better service to the blind, and of expending economically the funds at its disposal. For several years magnetic tape recording has been under investigation and a prototype machine, suitable for manipulation by the blind, has been produced and is now undergoing tests in the field.

The advantages offered by magnetic recording can be realized only by using much narrower tracks than are usual, and by adopting single cassette loading for both supply and take-up spools. In the machine illustrated the track width is only 10 mils (0.01 inch) and with spacing between track centres equal to twice this distance, up to 24 tracks can be accommodated, without "crosstalk," on ½-inch wide tape. Each track gives 30 to 35 minutes duration, so that a total of 12 hours can be recorded on each cassette —a 50 per cent increase over the equivalent 10-record disc unit. There is also the advantage that only a single unit is involved and there is no possibility of getting the recordings mixed up in the wrong order. Yet another advantage is that new books can be recorded and issued quickly, since the time taken for processing and pressing discs is eliminated.

In a general-purpose magnetic tape recorder/reproducer, designed for music as well as speech, it is necessary to provide equalizing networks to give a level overall frequency characteristic. Since clear articulation is of greater importance in a talking book than exact fidelity to the spectrum of the original speaker's voice, it is permissible to omit the equalization and allow the response curve to rise. This greatly simplifies the circuit, minimizes hum troubles and generally conduces to reliability.

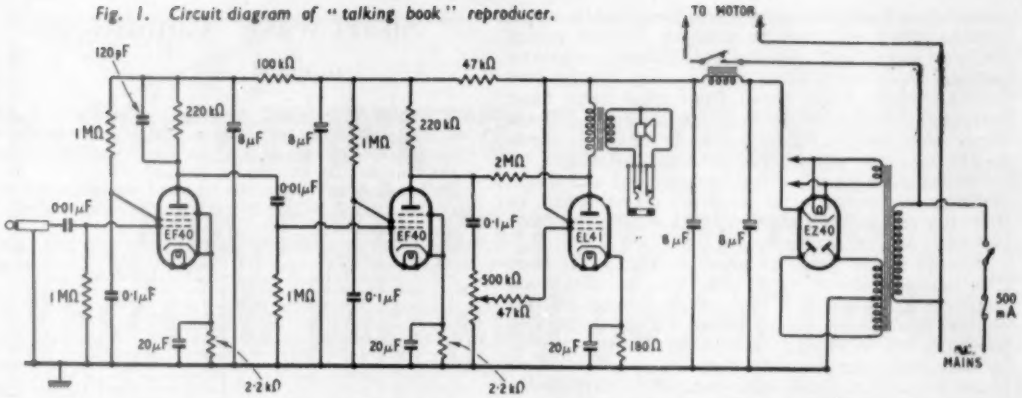
The amplifier, shown in Fig. 1, has a "flat" characteristic and a voltage amplification to the grid of the output valve of 10^4. Negative feedback is applied by a 2-MΩ resistance between the anodes of the last two stages. A relay in the h.t. circuit controls the tape motor and ensures that this cannot be started until the valves have warmed up and the amplifier is ready to function. The winding of the relay serves also as the h.t. smoothing choke. A three-position switch first switches on the amplifier and then mechanically engages the friction drive to the motor.

The driving mechanism for the tape spool spindle is also of simple and reliable design and consists of a large-diameter rubber-tyred wheel driven through a double-stepped idler reduction gear from the motor spindle. The driven spool therefore revolves at constant speed (actually π (3.14) seconds per revolution). Consequently the tape speed varies according to the diameter of the tape on the take-up spool from 3¾ to 7½ in/sec. This is no disadvantage since, at any point on the tape, the linear speeds for recording and reproduction are the same. With a short gap in the pickup head and modern tape coatings, the high-frequency response at 3¾ in/sec is more than sufficient for speech, while at the higher speeds the h.f. response is progressively curtailed during recording.

The essential simplicity of the reproducer unit is preserved by incorporating the rest of the tape winding mechanism, together with the playback head, in the cassette. The cassette unit is necessarily more complicated, but as it automatically returns to the library at frequent intervals, an eye can be kept on it for incipient troubles.

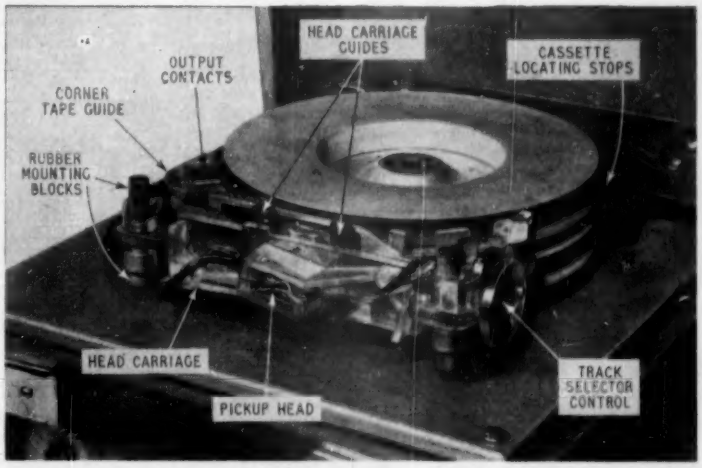
Two aluminium spools are mounted, concentrically and independently, on each end of a spindle bolted to a fixed central web plate with resilient rubber mounting blocks which locate it between the two halves of the cassette. A limited amount of movement is allowed at the centre so that the lower (take-up) spool falls by gravity on to the centre spindle

Fig. 1. Circuit diagram of "talking book" reproducer.

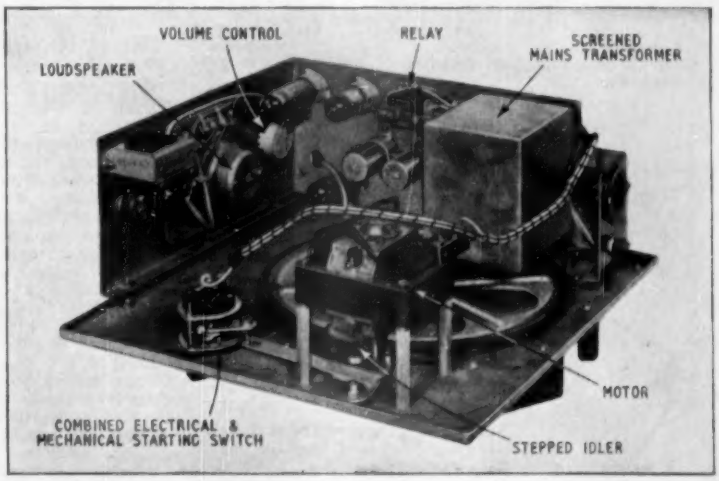


and picks up the drive when the holes in the drum engage two spigots on the spindle. The tape passes over corner guides and under the pick-up head, which is housed in a carriage mounted on guides running approximately at right angles to the length of the tape. The carriage is located by stops at each end which slide on wedges formed by a plate of the approximate shape shown in Fig. 2. This plate is constrained to move in a line parallel with the fixed baseplate and is under the control of a lead screw, the thread of which (in conjunction with the degree of taper on the wedges) gives 20 mils lateral movement to the head carriage for each complete revolution of the control knob. The latter is provided with a detent for each revolution so that the blind person can feel as well as hear when the next track has been engaged. The cassette is, of course, turned over manually between tracks and what was the take-up spool then becomes the supply pool. Electrical contact between the playback head and the amplifier is effected by a cut-down telephone plug and springs forming a socket in the cassette.

The tape is graphited to reduce friction and, incidentally, to reduce static charge effects. The head carriage and baseplate, which in the model illus-



Tape winding mechanism and track-locating device for pickup head and (below) underside of reproducer chassis showing friction-driven reduction gear.



trated have both been hand-made from Perspex sheet, will in future machines be made as graphite loaded Bakelite mouldings. Spring-loaded phosphor bronze annular tapes are fitted to each spool to control tape spilling which might result from inadvertent hand winding of the spools in the wrong direction. These tapes also help in reducing static charges, which might otherwise build up under some conditions.

Recording is made with the same head and track-shifting mechanism as is used for reproduction, so that the relationship between head and tape is fixed for each cassette assembly.

Details of the head are given in Fig. 3. It is of the high-impedance type with two bobbins each carrying 6,000 turns. The gap is formed by two 0.01-in laminations, copper-plated 0.00015-in thick at the tips, butted together and soldered into a slot in a hard nickel-chrome alloy tape bearer plate. Two pairs of 0.015-in laminations complete the magnetic circuit. A split Mumetal shield surrounds the windings, and an additional guard plate (not shown) is mounted facing the air gap.

The narrowness of the track is not, theoretically, a disadvantage from the point of view of signal/noise ratio, though the available total output is, of course, reduced. In practice, however, the narrow track is very sensitive to blemishes in the coating of the tape and very quickly sorts the sheep from the goats among commercially available tapes.

With a good tape, however, a side-by-side comparison would be necessary to say whether the speech quality from the experimental "talking book" was in any way inferior to that from a conventional portable twin-track magnetic recorder. Certainly the hum and surface noise are quite unobtrusive, and the clarity of diction is impeccable.

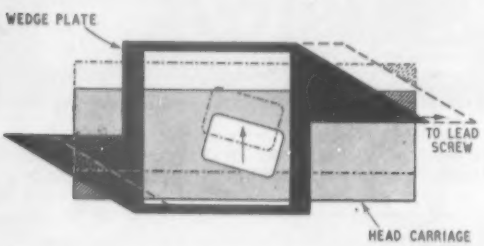


Fig. 2. Illustrating the principle of the track-locating mechanism.

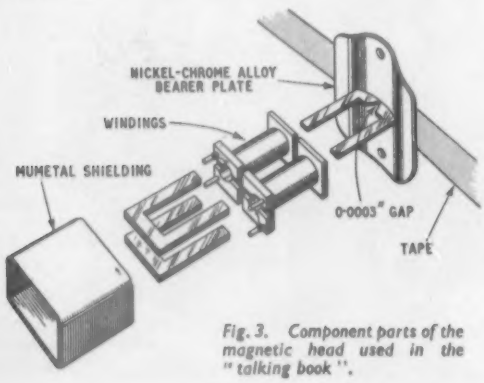


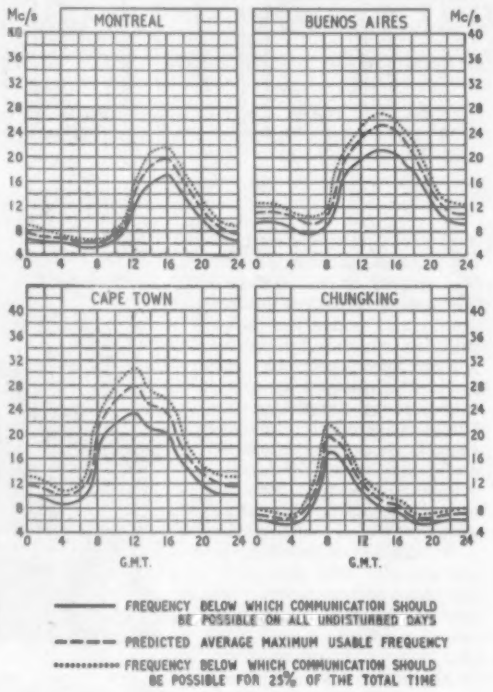
Fig. 3. Component parts of the magnetic head used in the "talking book".

Short-wave Conditions

Predictions for January

THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during January.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.



THE "IONOPHONE" DEMONSTRATED

AN informal lecture on "Loudspeaker Systems—Recent Trends in Design," given recently by A. E. Falkus, B.Sc.(Eng.), to the Radio Section of the Institution of Electrical Engineers, included a demonstration of the "Ionophone,"* a diaphragm-less loudspeaker depending on the heating effect of a current through ionized air. The driving element was a quartz tube about 3in long, closed by an electrode at one end, working into a small horn with throat and mouth areas of 1cm² and 50cm² respectively.

The lecturer said that the element was truly aperiodic, tests and delay response experiments on the combined horn and element showing linearity from 600 to 20,000 c/s. For the lower frequencies a 15-in cone unit was employed, with a cross-over network designed for 800 c/s.

A source of radio-frequency power is necessary for the "Ionophone," and the lecturer stated that suitable frequencies lay between 14 and 40 Mc/s. In the model demonstrated the r.f. power was 60 watts at 20 Mc/s. Possible interference had been forestalled by the use of screening and mains filters.

* See *Wireless World*, January 1952.

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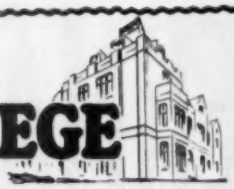

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By N. C. J. BENNETT, Governor of the College

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Motor Engineering
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Power Station Eng.
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As a result of an extensive research and development programme by the Rectifier Division of Standard Telephones and Cables Limited, there is now available a range of prototype Germanium Junction Power Rectifiers and, for the first time in this country, a range of prototype Germanium Junction Photo-Electric Cells. Features of these new components include small size, high output, and complete hermetic sealing using glass-to-metal seals thus ensuring long life and stable characteristics. These new "Standard" products will meet a variety of needs within the Electrical, Electronic and Radio industries. "Standard" Engineers are now prepared to co-operate with users to produce these components to meet individual requirements.

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Making a Universal Shunt

By A. L. CHISHOLM

IN the July issue of *Wireless World*, an ingenious way of adjusting an ammeter shunt was described. This method is ideal for single-range ammeters, but cannot be used for making the much more useful Universal Shunt. This is the type which is used in most commercial multi-range meters and its virtues are too well known to need elaboration here. Cazally and Roddam describe it in detail in "AC/DC Test Meters" (Pitman) but the method of construction they give is cumbersome and is really beyond the scope of the amateur. The method of construction given here is quite simple to carry out and requires only the ordinary workshop equipment.

Let us assume we have a meter of full-scale deflection 1 mA and resistance about 50 Ω—we do not need to know the exact value of the latter. We desire to make a shunt to give us ranges of 5 mA, 50 mA, and 500 mA. Then the arrangement is as shown in Fig. 1.

For the 500-mA range, 499 mA flows through R_1 when 1 mA flows through the other resistances in series.

$$\therefore 499 \times R_1 = 1 \times (R_2 + R_3 + r)$$

where r is the sum of the meter resistance r_m and the series resistance r_s.

Then $$\frac{499}{1} = \frac{R_2 + R_3 + r}{R_1}$$

Add 1 to both sides

$$\therefore \frac{500}{1} = \frac{R_1 + R_2 + R_3 + r}{R_1} \quad .. \quad .. \quad (1)$$

In the same way, for the 50-mA range

$$\frac{49}{1} = \frac{R_2 + r}{R_1 + R_2}$$

or $$\frac{50}{1} = \frac{R_1 + R_2 + R_3 + r}{R_1 + R_2} \quad .. \quad .. \quad (2)$$

For the 5-mA range, we get

$$\frac{4}{1} = \frac{r}{R_1 + R_2 + R_3}$$

or $$\frac{5}{1} = \frac{R_1 + R_2 + R_3 + r}{R_1 + R_2 + R_3} \quad .. \quad .. \quad (3)$$

Dividing (1) by (2) we find

$$\frac{R_1 + R_2}{R_1} = \frac{500}{50} = \frac{10}{1}$$

Dividing (2) by (3)

$$\frac{R_1 + R_2 + R_3}{R_1 + R_2} = \frac{50}{5} = \frac{10}{1}$$

If we put $R_1 = 1\,\Omega$, solution of these equations gives $R_2 = 9\,\Omega$, $R_3 = 90\,\Omega$ and r comes out at $400\,\Omega$. This value of r is unnecessarily high and the meter would be more efficiently used by making r one-fifth of this value — that is $80\,\Omega$. This gives $R_1 = 0.2\,\Omega$, $R_2 = 1.8\,\Omega$ and $R_3 = 18\,\Omega$.

Now the difficulty of construction centres round the resistance R_1. It is not easy to make a resistance accurately 0.2 Ω. Contact resistances and resistance of connecting wires all become important making accuracy difficult to achieve. However the exact size of R_1 is not important, as shown above, provided the various resistances are in the correct ratio. Fortunately, this is much easier to attain.

The author has found the following method of construction very successful. A former is first made of Paxolin strip, as shown in Fig. 2, and No. 22 gauge tinned-copper wire threaded through holes acts as anchorage points. R_1 is made as nearly as possible to size by measuring off the length of wire, calculated from resistance wire tables—it is better to make the resistance too high than too low. The wire is wound in the R_1 space and the ends are securely soldered to C and D. Then R_2 is measured off by length so that it is a little greater than the calculated value (1.8 Ω). One end of the wire is soldered to C and the other end is cut until the ratio of R_1 to $R_1 + R_2$ is exactly 1 to 10. There are many ways of measuring this ratio but the author used an ordinary school metre bridge, a single dry cell in series with a flash lamp bulb (to limit the current), and the 1-mA meter as indicator, with complete success. If a metre bridge is not available, one can readily be improvised with a metre stick and a length of resistance wire. The final adjustment should be made with the free end of R_2 soldered to B.

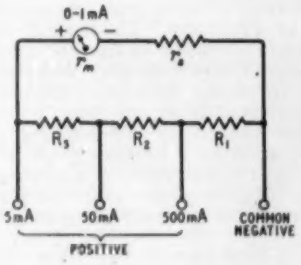
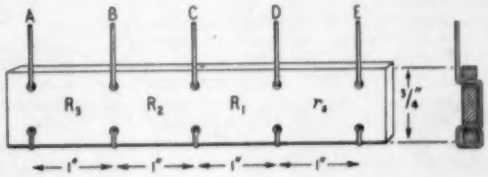


Fig. 1. Connections for universal shunt.

Below : Fig. 2. Paxolin former with wire connectors.



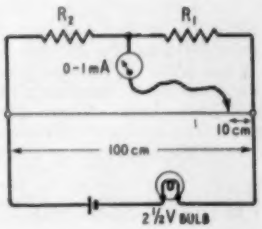


Fig. 3. Simple bridge for measuring the ratio of R_1 to $R_1 + R_2$.

In the same way, R_3 is measured off and adjusted until the ratio of $R_1 + R_2$ to $R_1 + R_2 + R_3$ is exactly 1 to 10.

The adjustment of r_s (about 30Ω) is made most easily by using another meter which can indicate a current of 5 mA. The 1-mA meter is joined between A and E and an external circuit consisting of a battery, variable resistance and the 5-mA meter is joined to A and D. Then r_s is adjusted so that when 5 mA is flowing through the external circuit, the 1-mA meter shows full-scale deflection.

If it is desired to have the original 1-mA range still available, a switch must be fitted to open one of the leads connecting the meter to the Universal Shunt. This must be done also if the meter has to be used as a voltmeter or ohmmeter.

Simple Linearity-Measuring Instrument

By K. G. BEAUCHAMP, A.M.Brit.I.R.E.*

For Checking Television Scanning

ONE of the most important criteria of television scanning circuits is the linearity of the display on the cathode-ray-tube screen.

As a check on the linearity of these scanning circuits a pattern generator of a type previously described elsewhere[1] is often employed or alternatively the B.B.C. test pattern is utilized. In either case measurements are taken of the distance between pairs of parallel vertical or horizontal bars over different portions of the screen face. The linearity can then be expressed as a percentage increase or decrease of this distance about the mean spacing of the bars.

When this information has been obtained it may be presented in several forms. A complete picture of the performance of a scanning circuit in this respect is given by a linearity graph of the form shown in Fig. 1. Alternatively, a figure can be given of the greatest departure from correct linearity as a percentage of the mean bar spacing, e.g.,

$$\text{Non-linearity} = \frac{200\,(a-b)}{(a+b)}\ \%$$

where,

a = width of widest bar spacing.
b = width of narrowest bar spacing.

In order to facilitate the measurement of scanning circuit linearity the author has constructed a simple device which will enable the required measurements to be obtained quickly and accurately.

To avoid parallex error the instrument has been designed on the lines of a travelling microscope, and consists of two parts; a graduated scale 44 cm in length mounted on a rectangular section of Paxolin tubing for rigidity and lightness, and a movable brass sleeve carrying the eyepiece.

This latter is constructed from a short length of ½-inch diameter Paxolin tubing closed at each end by a Perspex cheek. Upon the Perspex at the far end are scribed crossed hair-lines, and a small diameter hole at the near end to enable the instrument to be accurately aligned and so avoid the parallex error previously mentioned.

In order that the device may be brought into use quickly and to dispense with cumbersome mounting arrangements, two rubber "suckers" are fitted 8 inches apart on the back of the graduated scale.

Due to this method of attachment, coupled with the method of alignment, measurements may be taken from completed receivers enclosed in their cabinets by "sticking" the instrument on to the implosion guard covering the tube face.

A photograph of the completed instrument is shown

* General Electric Company, Coventry

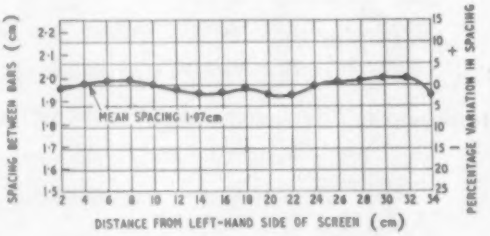


Fig. 1. Linearity graph for a line-scanning circuit.

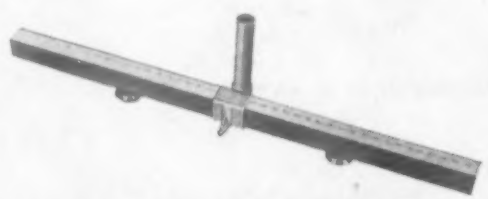


Fig. 2. The complete instrument standing on the rubber suckers. The optical system is housed in the vertical tube.

[1] "A Transmitter for Production Testing of Television Receivers," by J. M. Siberstein, *Electronic Engineering*, June 1953.

in Fig. 2 from which the construction can be clearly seen. To ensure rigidity and prevent the scale from vibrating on its rubber supports, a stabilizing lug has been soldered to the brass sleeve. This can be seen beneath the sleeve in the photograph of Fig. 2.

When using this instrument, however, we must bear in mind that when viewing a picture displayed on a cathode-ray tube we are really looking at a projection of a flat picture on to the curved surface of the screen face, and some distortion is bound to occur if an ideal flat picture is displayed upon it.

The form of projection used is therefore important if distortion is not to be experienced. This has already been considered by Jacob[1] who suggests that minimum distortion is apparent when a form of stereographic projection is employed for this makes it possible to reproduce shapes accurately over the entire screen face.

As a consequence, unless the instrument is used with a flat screen projection-type receiver some correction of the measured results is necessary. This arises because the instrument is used effectively to measure a flat picture projected from the curved surface of the tube face, giving rise to the distortion referred to above. This may be quite small and for many types of cathode-ray tubes in current use can be neglected unless extreme accuracy is required.

The exact extent of the correction will be seen to be dependent on two factors:

(a) The radius of curvature of the tube face (r).

(b) The maximum picture width (w).

From the diagram of Fig. 3 the aperture ϕ can be expressed as:

$$\phi = 2 \sin^{-1} \frac{w}{2r} \quad .. \quad .. \quad .. \quad .. \quad (1)$$

In order to estimate the extent of this error over the screen face let us divide this angle into a number of small increments ψ radians as shown and assume that a number of linearity bars are produced at points a, b, c, etc. Then the distance between these bars l, m, n, etc., will be small equal sections of the screen face of length:

$$l = m = n = r\psi \quad .. \quad .. \quad .. \quad .. \quad (2)$$

Now the apparent distance between the bars, such as would be measured by the instrument, can be found by assuming the screen to be flat over these small segments and following a tangent to the radius r at the centre of the section being measured, i.e.:

$$l' = l \cos \theta = l \cos \frac{\phi}{2} \quad .. \quad .. \quad .. \quad (3)$$

$$m' = m \cos \left(\frac{\phi}{2} - \psi\right) \quad .. \quad .. \quad .. \quad (4)$$

$$n' = n \cos \left(\frac{\phi}{2} - 2\psi\right) \quad .. \quad .. \quad .. \quad (5)$$

etc.

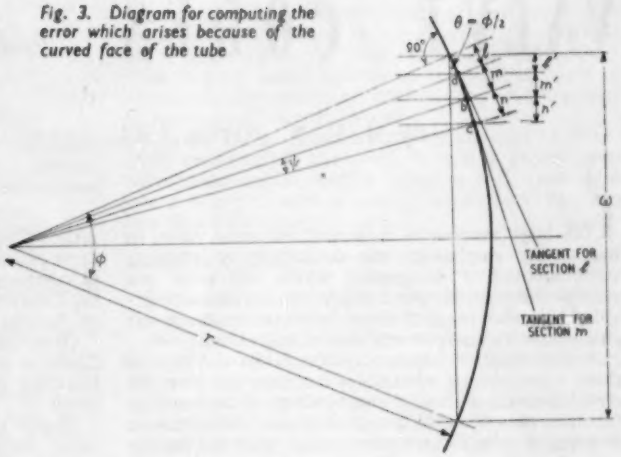
Giving rise to a maximum subjective error of:

$$\frac{l - l'}{l} \cdot 100\% = \left(1 - \cos \frac{\phi}{2}\right) \cdot 100\% \quad .. \quad (6)$$

Knowing r and w for the cathode-ray tube in the receiver being measured, then a correction graph can be constructed and used in interpretating the results obtained by measurement. A typical graph of this nature is shown in Fig. 4 for a 14-inch rectangular tube, and it will be seen that a maximum error of 2.7% is obtained at the extreme edges of the picture. This is for the line scan and in the frame direction the correction will be smaller and amount to only 1.5%.

When measurements of linearity are taken from tubes having a greater radius of curvature, such as the earlier blown bulbs, then the correction factor assumes some importance and may be as high as 8–10% which is comparable to the maximum scanning distortion that can be tolerated in a domestic television receiver.

Fig. 3. Diagram for computing the error which arises because of the curved face of the tube



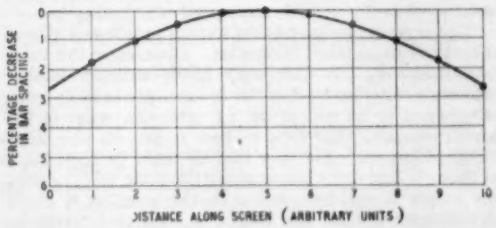


Fig. 4. Correction curve for a G.E.C. 7201A tube of the 14-inch rectangular type

[1] "Television Monitors," by J. E. B. Jacob, *Wireless World*, June, 1950.

Two-Band Transmitter Receiver

DETAILS of coils L_3 and L_4 (Fig. 2, p. 595, December, 1953, issue) were unfortunately omitted. They are the same as the corresponding coils L_9 and L_{10} with the addition of a tapping 3 turns from the earth end on L_3 and 6 turns on L_4. Theoretically, R, in Fig. 1 should be 400 ohms when 6AM5 valves are used, but the 100 ohms should hold the cathode currents at a safe value. Also in Fig. 1 a 0.01-μF capacitor ought to be joined from the g_2 end of AFC_1 to earth. In the list of components for the receiver R_{14} was omitted; it should be 33 kΩ, 1W. P_2 should be 50 kΩ potentiometer.

In the list for the transmitter the tapping on L_9 should be 20 turns from the *anode* end. At the top of the right-hand column on page 594 capacitor values in the "pi" network should read: 500 and 300 pF for the variables in this order and 330 and 680 pF fixed respectively.

VALVE CODES

Problems of Devising a Useful and

By M. H. N. POTOK,* B.Sc., A.R.T.C., A.M.I.E.E., A.M.Brit.I.R.E.

THE large number of radio and industrial valves in use to-day emphasizes the desirability of evolving some method of designation which will serve not only to distinguish valves which are not interchangeable, but also to give some information about the characteristics and potentialities of individual types.

A sequential numbering system fulfils the first of these requirements admirably, but does not give the vital information about the valve which is the essential function of a code. One of the chief difficulties in devising a code is to ensure that it shall be flexible enough to cope with unforeseen developments; this is never a problem with sequential numbering.

The arguments for having a code are, that it places the valves in suitable categories. Looking at the valve code number, the user may know without further reference whether it is a diode or a pentode or even whether it is an a.f. or an r.f. pentode, what is the heater voltage, what type of base it has, its size, type of envelope, etc. He may find all those or only some of them. The more information the code will contain, the longer it will be. But even the simplest is likely to eliminate at least one source of error and exasperation in selecting valves. It will also speed up the process of choosing a series of different valves to be used in a single piece of equipment. It will simplify redesigning, using modern valves as they appear. It may help the user to assimilate new developments by referring to types known to him under the code.

Let us take a few examples. Originally each branch of the Armed Services had its own designation system for valves. This has now been unified under a common valve (CV) system, which is strictly sequential. In it CV 138 is a well-known miniature, high g_m, 6.3-V heater, pentode; CV 129 is a 3-cm klystron. CV 2000 may be anything or nothing. The system covers virtually all electronic devices. It is ideal for stores.

In the Mullard code, EF 37 stands for a 6.3-V heater, voltage pentode amplifier on octal base (the last figure denotes a particular development of this type). PL 80 should be a 300-mA series heater, power output pentode with Noval 9-pin base. When EF 81 is advertised as a new product the user will subconsciously add this to the list of valves he knows something about.

In the R.T.M.A. American code 6J5 stands for a 6.3-V heater with five independent useful elements. It turns out to be a low-μ triode. 6J6 is a double triode while 6J7 is a pentode. All have 6.3-V heaters but give no information about anything else and no clue as to what, say, 6J8, would be.

On the whole it would appear that a code is preferable to a sequential system, but before giving a final judgment, let us examine what we want from a code.

It should be fairly clear that a good code should give the maximum amount of information, and yet be short and easy to memorize and to reproduce. Let us examine what sort of information can be given by a code. There is, of course, no limit to that, but the most essential data are possibly:—(*a*) Heater voltage or current; (*b*) Type of base; (*c*) Type of envelope; (*d*) Electrode structure; (*e*) Power-handling capacity; (*f*) Special features; (*g*) Applications.

Obviously if each one of these were to be given by a figure or a letter, the code would be unwieldy and therefore useless. Let us look at some of them in detail.

Heater voltage or current: This is probably the safest information to be given about hot-cathode valves, and the simplest code would be a figure giving the nearest integral voltage. The difficulty arises with series-connected heaters operating at constant heater current. At present the heater voltage is not likely to exceed 100 V, while current is almost always 100 mA or more, thus one could say that one or two figures denote the voltage but three figures will denote current. The danger is that with miniaturization of valves low heater currents may become more common, upsetting the system. It might therefore be safer to use figures for both, but precede current by some pre-arranged letter such as O, so that 20 would stand for 20 volts but O20 would mean 20 mA.

Type of base and envelope: This is very useful information to have in a code, and is also safe in the sense that new developments or requirements are not likely to call for a change of designation of existing types. As long as one chooses symbols which allow for expansion no trouble should be experienced. The present multitude of bases, not only as far as number of pins is concerned, but also their distribution, sizes and material of the base itself, creates a serious problem. No limitation is possible, because new developments will lay stress on new base characteristics, demanding ever new types and structures. A number giving the number of pins is useless if one thinks of, say, B8A, B8G, International Octal, Mazda Octal—all 8-pin bases. It seems that it would be necessary to sacrifice a self-explanatory code and use a two-letter or two-figure group to describe the base and envelope.

Electrode structure.—It is difficult to foresee future developments, but possibly, as far as the present types are concerned, a simple system giving the number of electrodes could be adopted for the conventional types, with the code letter or figure doubled for twin valves. Letters would be preferred here allowing for a larger number of twin-valve types. Thus B would stand for a diode, E for pentode, CC for double triode, BBC for double diode triode, etc. Letters following K might be used for other types of valves more or less arbitrarily.

Applications.—While this information is very useful it is also one that may cause confusion when it is found, say, that a valve originally designated as a general purpose voltage amplifier turns out to be particularly useful for a very definite application. It is possible that recoding should be allowed then. An arbitrary choice would have to be made to codify the

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various applications by a two-figure or two-letter group. This code might also cover any special features, such as secondary emission, exceptional reliability, etc.

Power-handling capacity.—This information could be dispensed with as the power could be judged quite closely from the other information given. It is also in this field that most changes occur as experience is gathered and new circuits developed.

The code would already be probably so long as to be useless and yet it is not even complete, because some allowance must be made in it for relatively small variations within one general type. Makers and users each have different ideas about the best valve characteristics of a particular type, and that is bound to result in there being at any time several, say, r.f. pentodes with 6.3-V heaters on octal bases in glass envelopes, and they could probably be differentiated only by a serial number. As it is unlikely that more than twenty such varieties will be found on the market, a simple letter might be used here. Even so, the code might consist by now of nine figures and letters mixed, say, BG12CC18K, which might be interpreted as miniature 7-pin base, 12-V heater, double triode, low-μ, serial letter K, if only it could be memorized together with several dozen other valves one constantly uses.

Having arrived so far we have now to consider dropping some information. Heater designation is possibly the first one could omit. After all most valves operate at fairly standard voltages. The application might also be omitted as somewhat artificial. In the new code BE17P would then stand for, say, diode pentode, Noval base, serial letter P. (The serial letter or number, while not common from type to type, would in itself give some information.)

One should also consider the possibility of having a short and a full code, the short code giving valve structure, application and serial number, while an additional code would give heater voltage or current and base type, thus: CC18K/BG12. One would then normally use the short code only.

Should There be One Code or More?

The advantages of a code which ties a valve type to a particular manufacturer are primarily connected with the sales aspect. Since manufacturers enter the valve business to sell their products, this aspect must not be minimized.

It may be said that a code system which is so different from any other that it ties in the user's mind the valve type to its maker, adds to the prestige of a good firm. It may also be argued that a less knowledgeable user may buy a replacement which bears the same code, and therefore comes from the same maker, as the valve which has just died on him, even if other makers make an identical valve under a different code. This, however, cuts both ways, and therefore may not be as important as it would appear.

One important aspect of the individual maker's code is that it simplifies the code to the manufacturer, who himself is not likely to make as many types and variations of one type as may actually be on the market. Also any small improvement or selection may easily be distinguished by the user (as for example EF37 and EF37A, or 715A, 715B, and 715C, etc.). This is very useful as long as the various codes in existence at one time do not confuse the user. Simplicity is also a great advertising asset.

On the whole, however, even at the cost of somewhat complicating the code, it would appear—and current American practice supports this view—that one code is preferable to many, with a central registration board allotting the code.

Current Codes

Let us now look at the codes used by the leading manufacturers and comment on them individually.

Mullard.—First letter stands for type of heating and voltage or current. Second letter and following denote the electrode system.

The first figure denotes type of base. Second figure stands for a serial number of a development.

The following table gives details of the meaning of letters and figures as placed:

	If first letter	If second or following letters
A	4 V, a.c., parallel	Diode
B		Double diode
C	200 mA, a.c./d.c., series	Triode
D	Battery 0.5–1.4 V	Power triode
E	6.3 V series or parallel	Tetrode voltage amplifier
F		Pentode voltage amplifier
G	5 V	
H	150 mA, a.c./d.c.	Hexode
K	Battery 2 V	Heptode or Octode
L		Output tetrode or pentode
M		Beam indicator
N		Gas triode
P	300 mA, a.c./d.c.	Secondary emission (if third letter)
Q		Nonode
U	100 mA, a.c./d.c.	
X		Gas filled full-wave rectifier
Y		Half-wave rectifier
Z		Full-wave rectifier

Figures:

1–19 various	50–59 B9G
20–29 B8G Loctal	60–70 sub-miniature
30–39 Octal	80–89 B9A Noval
40–49 B8A Rimlock	90–99 B7G miniature

This system was very good indeed, and largely self-explanatory, but it now shows sign of breaking down, especially in the miniature and sub-miniature ranges,

because of numerous new developments. It certainly could not cope with all possible variations already on the market. In spite of that it remains the only code in use anywhere which is strictly logical.

Marconi, E.M.I., G.E.C., Osram, M.O.V.—The code consists of a letter or letters and a serial number. The letters stand for :

A—Special industrial applications	M—Metalizing (when used later in code.
D—Diode or double diode	N—Output pentode
GU—Gas-filled rectifier	U—Rectifier
GT—Thyratron	W—Var. μ screened pentode.
H—High-impedance triode	X—Frequency changer
KT—Kinkless tetrode	Y—Tuning indicator
L—Low-impedance triode	Z—Sharp cut-off screened pentode

This system is very simple and flexible. As types and applications multiply so, presumably, the list will grow longer and longer until it will be impossible to remember anything useful. No information is given about heater or base, but that could be added easily.

Ediswan, Mazda.—The first figure or figures give heater voltages or current, thus :

1 = 1.4 V 10 = 100 mA
6 = 6.3 V 20 = 200 mA

followed by a letter or letters :—

C = Frequency changer
D = Diode or double diode
F = Voltage amplifier, tetrode or pentode
K = Small gas triode or tetrode
L = Voltage amplifier triode or double triode
M = Tuning indicator
P = Power amplifier
U = Half-wave rectifier } without first figure
UU = Full-wave rectifier }

followed by a serial number.

This system is similar to the previous one, but with heater information which is only useful in the very limited range used.

Brimar (S.T.C.).—Three codes are used :

(1) If the valve is for export, the American RTMA code is adopted sometimes with a prefix SV.

(2) If for home market the code consists of a figure or figures, such as :

1—Half-wave rectifier 9—Var. μ pentode
8—R.F. pentode 20—Triode hexode

followed by a letter

A for 4-V heater
B for 2-V heater
D for indirectly heated, other than 2- or 4-V cathode

followed by a serial number.

(3) If special valves, the code consists of a number, such as :

2 = Diode 5 = Pentode
3 = Triode 22 = Double diode, etc.
4 = Tetrode

followed by a letter giving maximum anode dissipation and type,
followed by a serial number,
followed by one or two letters to indicate base type and special features.

The above systems provide the remaining variations of figures and letters although it will be noted that, say, 20D1 may mean 200mA. heater, diode (Mazda), or 6-V indirectly heated triode hexode (Brimar).

The last mentioned is the most elaborate of all, for example, 33A/158M is a double triode, anode dissipation under 10W., 158 is serial number, M stands for B8G base. It would be interesting to find the reaction of users to this code. It fails in not being flexible enough in describing the electrode system unless a new structure such as a klystron will be classed under a completely different code.

Continental makers such as Philips, Tungsram, Siemens Halske, use a code common with Mullard (given above).

American (R.T.M.A.) Code. All American leading manufacturers register any new valve they produce with this organization (Radio Television Manufacturers' Association) which allots it a code unless the difference between it and any existing valve is such that no knowledge of the difference is recognized to replace one by the other. This code consists of a first number symbol indicating rated filament or heater voltage within -0.4 to $+0.6$V, a first letter symbol consisting of one or two letters which in themselves are of no apparent significance, a second number symbol indicating the number of independent useful elements for which terminals are provided, without consideration of their function, heater or filament counting as one, as do combinations of one or more elements connected to one terminal.

A second letter or letters indicating distinguishing features, such as :—

G = Glass tube on octal base
GT = Above in a T-9 bulb
X = Low-loss base
Y = Intermediate-loss base
M = Metal-coated glass envelope on octal base
W = Military type assigned on behalf of armed forces.
A, B, C, D, E, F = a modified version of a type without the suffix.

Valves used specifically for industrial purposes have a sequential designation beginning with the number 5500.

Several manufacturers still use their own codes for special valve types but these are not common.

The main R.T.M.A. code, described above, gives only the heater voltage as a definite information, all the others being, more or less, differentiation marks or serial numbers. Some of the symbols such as G, GT appear to be vestigial and no equivalent symbols have come into use for other types of base and bulb. If one has to remember the difference between CJ5, 6J6, and 6J7, one might as well call them CV1933, CV858, and CV1936, respectively, as in the British Armed Services System.

Conclusions

While it does appear that a valve type code is preferable to a sequential system, there are very serious difficulties in deciding on a suitable and lasting code. Apart from those mentioned, one has to remember that other electronic devices will require codes as well and these must be such as not to be confused with the valve codes proper.

Possibly the best first step towards a solution would be for one of the professional institutions to organize a series of discussion meetings leading to the setting up of a committee representing manufacturers, users, Services, institutions, and the British Standards Institution, which should then give the findings of the committee its full sanction.

Acknowledgements : The author wishes to thank the manufacturers mentioned in the report as well as the Radio-Television Manufacturers Association (of U.S.A.), the Joint Electron Tube Engineering Council (of U.S.A.), Sylvania Electric Products Inc., Bell Telephone Laboratories, both of U.S.A., and Hivac for their co-operation.

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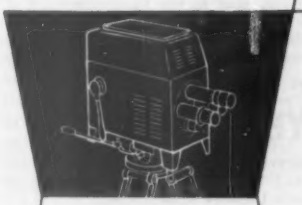

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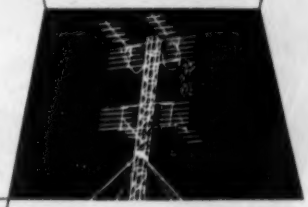

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How Fast is Electricity?

"CATHODE RAY" Makes Us Think Again About Currents

IT is a great pity that we are not all together so that we could hear one another's answers to this question. I am sure they would be most interesting. Probably those who are young enough to have been brought up on the "electronic approach" to electrical theory would be cautious and seek further information on what was meant by "electricity" before committing themselves to a firm answer; but not so long ago I heard a professional electrical engineer express surprise when someone cast doubt on his clear-cut idea that electricity travelled at the speed of light or thereabouts.

Nature of Electricity

Well of course the question is nearly as vague as "How long is a piece of string?" so we shall have to heed the cautious young men and say what we mean by "electricity." It is not enough just to substitute the words "an electric current." What is an electric current? It can be several different things, and perhaps more than one of these things at the same time. I suppose we couldn't go far wrong in defining it as a movement of electric charge. But that raises one complication right at the start: there are positive and negative charges. I have no intention of our becoming deeply involved in nuclear physics, so, firmly ignoring the boys from Harwell and all the special effects that to them may be normal, let us stick to the simple broad picture showing all matter as made up of atoms each having at the centre an electrically positive "sun" or nucleus, with electrically negative electrons circulating around it like planets, the number of such electrons depending on the element concerned—one for hydrogen, six for carbon, twenty-nine for copper, and so on. The positive charge carried by the nucleus is normally cancelled out by the negative charge of the satellite electrons, but if by any means one or more of the electrons become detached, what is left has a positive balance and is called a positive ion, or often just an ion. A current of electricity from A to B, then, consists of electrons moving from B to A and/or positive ions moving from A to B.

If the current is flowing in solid material, the ions are the fixed material itself, so cannot move, and the current consists wholly of electrons. In gases the ions too can move, but as they are thousands of times heavier than the electrons the general effect is rather like rowing boats streaming one way and Atlantic liners the other, both kinds of craft being propelled by identical outboard motors. In a vacuum, all matter is, by definition, absent. No vacuum is perfect, however, and the best pumping arrangements leave behind about a thousand million molecules, (i.e., small groups of atoms) in every cubic inch. But for most practical purposes this number is quite negligible —like the same number of flies in a space as big as the world.

Our simple picture (unobscured by all the quantum theory, Fermi-Dirac statistics, uncertainty principle and suchlike filled in by modern scientists) shows insulating materials to be built of molecules with electrons firmly attached, so that nothing can move and hence there is no current. In metals, by contrast, the electrons are free to move. And they do; not only when there is any organized inducement, but all the time, like a random crowd milling around, or a swarm of angry wasps in a box. These random movements are uncontrollable, except by temperature—the hotter the material the livelier the movement. Nevertheless, according to our definition *any* movement of an electron must be an electric current. But because the movements are random there is no tendency to move in any one direction more than another. At any given time, for every million electrons moving up a wire there are likely to be almost exactly a million moving down. So the tendency is for these tiny currents to cancel one another out. If you were to toss up a coin millions of times, for every thousand heads there would usually be just about a thousand tails. Occasionally—not very often—it would be exactly one thousand. Usually it would be a little more (positive) or a little less (negative). Taken over millions, the positives and negatives would average out to practically zero, but individual batches would fluctuate above and below. In the same way the vastly greater number of random electron movements in metal averages out to nothing—in other words, they do not result in any d.c.—but they fluctuate a little, up and down. The result is a.c. of no particular frequency, or, if you prefer, of every frequency.

Movement of Electrons

Is there any reason why, just for a moment, this fluctuation current might not be quite large, as a result of most of the random movements happening to move in one direction? No, there is no reason. Neither is there any reason why, if you are a football pool addict, you should not win £75,000. But it has been calculated that you would have to persevere for 300,000 years to have an even chance of doing so. The chance of heavy current as a result of a large proportion of random movements coinciding is even more remote. In practice they maintain a fairly steady average, enough to have considerable nuisance value in high-gain amplifiers, as "noise," but not perceptible otherwise. The speed of the electrons while they engage in this ceaseless activity, although no doubt of interest to physicists, does not have much bearing on our work. It is believed that at ordinary room temperature it is of the order of 100,000 metres (say 60 miles) per second. If electrons were like the lady who, when accused by the police of doing 50 miles per hour in a built-up area, replied indignantly that she couldn't have because she hadn't driven more than 10 miles in her life—if electrons I say, were like

her, they would complain even more bitterly, for they seldom move more than about 10^{-8} cm without colliding with something, so the inside of a piece of metal must be like a night-club dance floor.

Organized Currents

Let us turn now from these dubious activities to consider something much more to the point—the organized movements of electrons under the influence of an e.m.f. or potential difference. These are what are most usually understood by the term "electric current." As we are still dealing with solid materials—in particular, metals—ion movements are impossible, so there are only electrons to consider. One principle at work here is the attractive force between opposite charges. If by any means a lot of electrons are removed from one end of a wire, that end has a corresponding number of un-neutralized nuclei, and is therefore positively charged. This offers an attraction to the neighbouring electrons, which start moving towards it. In doing so they leave behind a positive charge, and this attracts the electrons immediately behind. And so on, until electrons throughout the wire are on the march towards the end from which some have been removed. This would soon create a positive charge at the other end, which would then offer a counter-attraction that would tend to bring the column to a standstill again (apart, of course, from the random movement which goes on all the time, over and above any definite drift one way or the other). But if the agent that removed the electrons from one end conveys them by a different route to the other end to fill up the gaps left by the retreating column, the movement—the electric current—can be kept going indefinitely.

Such an agent is what we call an e.m.f. By making one end of the wire more positive and the other end more negative it creates a difference of potential between the two ends. If, for example, this p.d. were 5 volts, and the length of the wire were 10 metres, the wire and all its electrons would be in an electric field of 0.5 volt per metre. The nature of electrons when they are in an electric field is to move (if they can) through it positive-wards. In metals they can move, but are greatly hindered by the vast numbers of molecules, with which they keep on colliding. In other words, even a metal has resistance. Supposing our wire has a total resistance of 1 ohm, the number of electrons that the 5 volt p.d. will cause to pass any fixed point per second will be 31.2×10^{18}. The electron-per-second is rather an inconveniently small unit of current, and moreover does not fit in well with volts and ohms; the practical unit—the ampere—is equal to 6.25×10^{18} electrons per second, so the current in our example is of course 5 amps. But for the purpose of calculating the speed of the electron current it is necessary to reckon it in electrons per second. It is also necessary to know how many electrons there normally are in a given amount of metal. The speed at which troops would have to move in order to pass a fixed point at the rate of 10 soldiers per second would obviously be greater if they were in single file than if they were marching in close ranks 20 abreast. I have never actually counted the number of free electrons per cubic centimetre of copper, so I have to take the physicists' word for it that it is not far short of 10^{23}. Since our copper wire has a resistance of 0.1 ohm per metre it is probably 26 s.w.g., whose cross-sectional area is 0.00164 sq. cm., so the number of free electrons in each centimetre length is about 1.6×10^{20}. This is about 5 times the number that pass every second when the current is 5 amps, so the marching speed must be about 0.2 cm per sec. Hardly competitive with the speed of light! And that is with a current sufficient to make the wire decidedly warm, so it is a speed that in practice would seldom be exceeded, or even reached. In power stations and places where thousands of amps are flowing, they have much thicker conductors to flow in, so the electron speeds are generally less.

Another thing: we have been assuming that our current is d.c., so that its movement is in the same direction all the time. But most currents are alternating. Even at the relatively low frequency of 50 c/s the electrons have only one hundredth of a second at a time in which to move forwards. So if the average value of current in a 26-gauge wire were 5 A (r.m.s., 5.5 A; peak, 7.8 A) the total extent of any electron's movement would be only 0.002 cm. Even that minute promenade is liberal compared with the allowance at radio frequencies. Suppose you have a 50 Mc/s television dipole, and being fairly near the transmitter it has induced in it an average current of as much as 0.1 mA. The diameter of the dipole is, say, $\frac{1}{2}$in, but owing to skin effect the current would be confined mainly to the outermost 0.0005in, so the effective cross-sectional area would be 0.005 sq. cm (equivalent to a 21-gauge wire) and the current density would be 20 mA per sq. cm. In our previous example the current density was 3,000 A per sq. cm—150,000 times as much—so the electron speed in the skin of the dipole is 0.2/150,000 or 0.0000013 cm/sec. But here the motoring lady intervenes to point out that the poor electrons never get anything like a whole second in which to keep right on at this fabulous speed; and she is quite right, for in point of fact each half-cycle of 50 Mc/s oscillation allows only one hundred-millionth of a second for each journey. The extreme distance travelled is therefore about 10^{14} cm! I am not sure what is the diameter of an electron or even whether it can be said to have a diameter, but one authority says it is somewhat greater than this. In which case, the Ancient Mariner has the best description of its activity—"Backwards and forwards half a length, with a short, uneasy motion."

Electricity in Aerials

All this must come as rather a shock to those who have pictured electrons dashing up and down aerials, let alone to any who still think in terms of the speed of light. To anybody at all, it must be difficult to imagine how such incredibly small movements—even in the aerial of a powerful transmitter they are sub-microscopic—can affect things many miles away. Seeing that 0.1 mA is far from being the smallest significant current, and 50 Mc/s far from being the highest known frequency, one begins to wonder if there may not be something wrong with data that lead to conclusions so hard to believe. Some physicists now say that not all the "free" electrons take part in currents, and if this is so the speed of those that do would be greater; but at most it would seem to be much less than we used to imagine.

So much for electric currents in solids. I don't propose to discuss currents through gasses, because they are complicated by the electrons bumping into

the gas molecules and ionizing them by knocking out electrons, not only augmenting the electronic current but starting a relatively slow ion current in the opposite direction. Let us go straight on to vacuum. Here there are no electrons—or anything else—in significant quantity, so they have to be brought in. The most usual way of doing this is to heat a metal surface coated with barium oxide or some such material, which causes electrons to boil off in vast numbers. If there is no electric field, however, they tend to hang around, as in Fig. 1, and by forming a negative charge close to the emitter they prevent others from coming away. So let us place another piece of metal some distance off (Fig. 2) and make it positive relative to the first. This creates an electric field between what are now two electrodes, and the electrons are attracted away from the first electrode, the emitter or cathode, towards the anode, as in Fig. 2. By this time, of course, everybody has recognized that we are in Lesson One on the two-electrode valve. But perhaps not everyone who has taken even a whole course on valves could say right off how fast the electronic current travels through them, or how one finds out.

Acceleration in Valves

This is where a little knowledge of elementary mechanics is a great help; in particular, what happens to freely movable things when a steady force is exerted on them. If you were unfortunate enough to fall out of a space-ship in level flight a few hundred miles from the earth you would be freely movable, because there would be no appreciable air to hinder you; and the force of gravity would be acting downwards on you. The result would be that you would move downwards with steadily increasing speed. In other words, the constant force would cause a constant acceleration.* In this case the acceleration would be approximately what is now widely know as g, which is an increase in speed of 32 ft/sec per second, usually abbreviated to 32 ft/sec^2. It is easy to find how fast you would be falling n seconds after you had started (provided it was not long enough to bring you into the atmosphere); it would be $32n$ ft/sec. What is not quite so easy is to find how fast you would be falling after having fallen m feet, but a little elementary calculus shows it to be $\sqrt{2gm}$, or $8\sqrt{m}$ ft/sec. The important fact is that the speed is proportional to the square root of force × distance.

Now each electron in a valve is "falling" towards the anode. The "force of gravitation" in this case is the electric field, which is reckoned in volts per centimetre or per metre. If you multiply this force by the distance through which it acts, the product is in volts. By analogy with mechanics one would expect the velocity imparted to an electron by V volts to be proportional to $\sqrt{V}$. It is quite a simple problem in basic theory to confirm this. At the start—assuming it is a standing start—the speed of an electron is zero, so it has no kinetic energy (energy of movement). But is has potential energy by virtue of the potential difference between it and the anode. This potential energy is equal to its charge multiplied by the potential difference; in symbols, eV. At the end of the journey this potential energy has been entirely converted into kinetic energy, which mechanics teaches us is half the mass multiplied by the square of the speed (or velocity)—$\frac{1}{2}mv^2$. Since this must (according to the law of conservation of energy) be equal to eV, we have

$$v^2 = 2\frac{e}{m}V$$

The ratio of charge to mass of an electron, e/m, has been found by experiment; it is 1.76×10^{11} coulomb/kg, so

$$v = \sqrt{2 \times 1.76 \times 10^{11} V} = 5.93 \times 10^5 \sqrt{V} \text{ metres/sec}$$

or $593\sqrt{V}$ kilometres per sec. or $368\sqrt{V}$ miles per sec.

One interesting thing about this is that the speed of the space current driven through a valve by ordinary anode voltages is of an altogether different order from that of the same current flowing through the connecting wires. At 100 volts it is 3,680 miles per second, which makes Duke and Lithgow look slow; but its 5 mA (say) in a 26-gauge anode lead is only doing about 0.002 *millimetre* per second! Another interesting thing is that the final speed depends only on the potential difference it has fallen through from rest, and not at all on the route it has taken or the uniformity or otherwise of the field accelerating it. So in Fig. 2, even if a negative grid were interposed, or the "space charge" of the relatively dense crowd of comparatively slow electrons near the cathode caused an appreciable local reduction of the anode's attraction, the speed of those ultimately reaching the anode would be just the same.

Although the speed developed by 100 V is still well below that of light, voltages of a million or more are commonplace in high-tension laboratories, and one can buy over the counter "linear accelerators" urging electrons on with the equivalent of several million volts. Suppose we are content with one million, and use the formula to calculate the final velocity; it is $593 \times \sqrt{10^6} = 593{,}000$ km/sec. But what have we here? A speed nearly twice that of light (299,792 km/sec)! According to Einstein and all modern physicists, that is impossible. The fault is in the formula, which does not allow for the fact that mass increases with speed. Up to about one sixth of the speed of light the increase is not more than 1%, so the formula is good enough up to 7,000 volts—perhaps even 15,000. But when the electron begins to compete seriously with the speed of light its mass increases very rapidly, and this ensures that it will never succeed in breaking the "light barrier." The

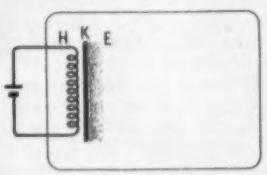

Fig. 1. Vacuum tube with a heater (H) which raises the temperature of a prepared surface (K) to the point where it emits electrons. These hang around in a cloud (E), their negative potential (space charge) tending to repel later emissions back to K.

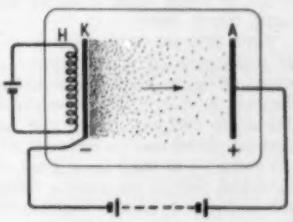

Fig. 2. When the negative space charge (E in Fig. 1) is neutralized by the high positive potential of the electrode A, a continuous current of electrons is set up from K to A.

* Actually, of course, the gravitational force would increase as the earth was approached; but not very much in 100 miles or so.

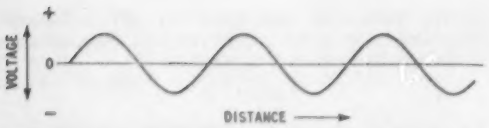

Fig. 3. Instantaneous graph of the voltage along a line carrying electromagnetic waves.

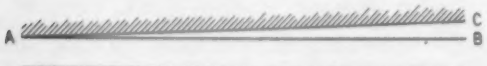

Fig. 4. The line AB represents an ocean wave rolling in towards a sea wall AC. During the time the wave takes to cover the distance from B to C, the splash on the wall has travelled from A to C.

voltage required would be more than infinitely great!

Whence, then, came the idea that electricity is as fast as light? Surely not from the fact that nowadays one can accelerate electrons to within 1% of that speed, but from the discovery that signals sent by electrical means—wire or wireless—go as fast. Now that we know that radio waves and light waves are the same thing except for frequency, and that frequency does not affect their speed, the idea that electricity is as fast as light is obviously correct if "electricity" is understood to mean "radio waves" or, more generally, "electromagnetic waves." If you connect a source of e.m.f. to the end of a pair of wires, it starts electrons moving in those wires. We have seen that (according to the data supplied by the physicists) this movement is incredibly slow, but that does not apply to the speed at which the *start* of the movement is passed along. One microsecond after you have made the connection, electrons nearly 330 yards along the line are starting to move. Assuming that the wires are insulated entirely by air—which in this particular respect is practically the same as nothing—the signal travels along the line at the speed of light. Solid insulating material increases the capacitance without any corresponding decrease of inductance, so the parts of line affected take longer to charge and the average speed is less. Along an ordinary r.f. coaxial cable it may be half the speed of light. But it is still enormous compared with the speeds of the individual electrons. You may start waving a suspended rope from side to side very slowly, but waves travel along the rope quite fast. With electrical signals the contrast is vastly greater.

Note that it is only a *change* in the electrical condition that goes at the high speed. If water is flowing very slowly and steadily through a pipe, nothing can be said to be travelling along the pipe any faster. But if the water is turned on and off, the effects are felt at the other end almost immediately, whereas the actual drops of water made to enter the pipe will not emerge until much later.

Now that we have progressed in stages from speeds of millionths of a millimetre per second up to the speed of light, 300,000 kilometres per second in round figures, it might well seem that there are no more worlds to conquer. Is it not basic to modern science that no speed can be faster than that of light? True; yet even so it may in a kind of way be possible for electrical signals to have a faster speed. When they are being sent as r.f. waves along an air-spaced line, the signals travel along it at practically the speed of light. If they could be "frozen" long enough for a graph to be drawn of voltage against distance along the line, it would be something like Fig. 3. Actually this voltage pattern would be travelling at the same speed as any group of waves forming (say) a Morse dot, so if it were possible to keep an eye fixed on a particular voltage peak its speed (the *phase velocity*) would be that of light. The group velocity and phase velocity in this case are the same. But if the signals were being sent along a waveguide this would not be so. It is too late to start explaining exactly how waves travel along a guide, but the nearer the wavelength is to a certain critical length the more they zigzag from side to side and the slower they travel directly along it. The group velocity, which is truly the speed of the actual signals, is therefore less than that of light—possibly much less. But the lower this speed, the longer the distance between successive voltage peaks along the axis of the guide, and the faster these peaks (or any other phases) travel. If the group velocity is half that of light, the phase velocity is double that of light. This may seem to contradict the laws of nature, but of course it only seems to do so. In actual fact it does not, because all that travels at this super-high speed is a phase pattern, not any actual energy or information. It is impossible, by doing anything at one end of the guide, to exert any influence on what takes place at the other end in a shorter time than light would take to do the distance. If waves are rolling in towards a sea-front very nearly at right angles to the coast, the splash of a wave arriving at one end A (Fig. 4) will travel very much faster along the front to C than the wave itself, which has only moved from B to C. No energy—still less any water—has travelled from A along with the splash.

What is the speed of electricity? Well, now you know!

Bigger and Bigger Tubes

THE trend towards bigger and bigger television screens, mentioned by our contributor "Diallist" in this issue, is confirmed by figures recently issued by the British Radio Equipment Manufacturers' Association. It will be seen from the following table that, whereas in 1950 40 per cent of the sets sold had either 9- or 10-inch tubes and only 2 per cent had screens of 14 inches or larger, the figures for the July/September quarter this year show that 72 per cent of the receivers sold had tubes of 14 inches or more.

	9in. and 10in.	12in.	14in.	15in.	16in.	17in.	Projection
1950	40%	56%	2%		—		2%
1951	13%	80%	4%		—		3%
1952	4%	71%	9%		14%		2%
Jan.-June 1953	3%	47%	24%	11%	3%	11%	1%
July-Sept. 1953	*	25%	36%	14%	2%	20%	*

* Combined sales of small-tube and projection sets totalled 3 per cent.

We understand that the combining of the sales figures in some cases is done to avoid disclosing information regarding the sales of individual firms where only one manufacturer is supplying a specific type of set.

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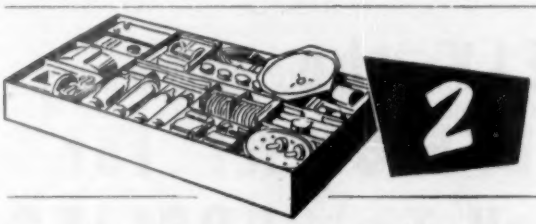

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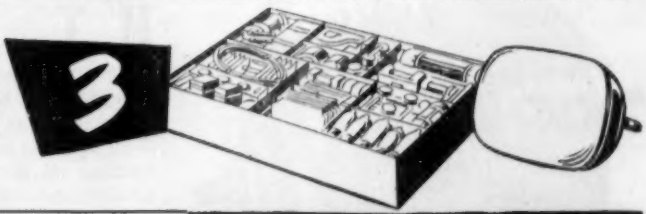

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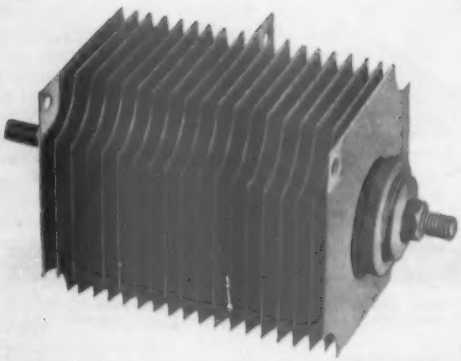

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C.R. Tube Safety

By W. TUSTING

Transient Conditions When Switching On and Off

IT is now the usual practice to use direct coupling between the video stage of a television receiver and the cathode of the c.r. tube. The grid of the tube is then connected to a potential divider across the h.t. supply, the grid potential being thus negative to the cathode potential and adjustable as a brightness control. A by-pass capacitor is usually connected between grid and negative h.t., as shown by C_1 in the figure, but sometimes it is joined between grid and positive h.t., as in the case of C_2. In the figure, C_1 and C_2 are to be regarded as alternative positions for the capacitor; the two are not normally present simultaneously.

If the effect of any ripple on the h.t. line is ignored, the capacitor is equally effective in either position. When the receiver is switched on or off, however, a transient condition exists during which the position of the capacitor appears, at first sight, to have a considerable effect; it appears, in fact, that it could influence the life of the cathode-ray tube.

It is argued that, because the charge on the bypass capacitor cannot change instantly, the grid is left behind when any sudden change of h.t. voltage, and hence of cathode potential, occurs. With the capacitor at C_1, for instance, a sudden drop to zero in the h.t. voltage would take the tube cathode to earth but leave the grid at its normal potential to earth. The grid would then be positive to cathode. Similarly, if C_2 is the capacitor, a sudden jump in the h.t. voltage from zero to its normal value would take the cathode up to its normal value, but, since C_2 would be uncharged, the grid would be carried right up to positive h.t. Again, the grid would be positive to cathode.

There is, in fact, nothing wrong with the argument; it is the premises that are at fault. If the h.t. voltage did, in fact, come on or go off instantly, the effects on tube life could be serious. But, in reality, the voltage cannot change quickly in normal switching on or off and so nothing to endanger the tube does occur. It is, however, worth while to examine the conditions in some detail.

First of all, consider what happens when a normally operating receiver is switched off. The h.t. voltage drops to zero, but not instantaneously, for the capacitors in the h.t. circuit take some small time to discharge. The time will vary quite a lot between different receivers because of the various forms of circuit employed and is, in any case, quite difficult to calculate accurately. As a rough approximation to it, however, we may consider the discharge of a capacitor equal in value to the total h.t. supply capacitance, through a resistor equal to the h.t. voltage divided by the total h.t. current. In a typical modern set the capacitance may be 200 μF and the resistance 250/160 $=1.56\,k\Omega$. The time constant is $200\times10^{-6}\times1.56\times10^{3}=3.12\times10^{-1}=0.3$ second. The voltage will have fallen to a negligible value in about four times this period or 1.2 sec. This agrees with practical experience, which is that a receiver goes on functioning to a decreasing extent for at least one second after it is switched off; sometimes it does so for appreciably longer.

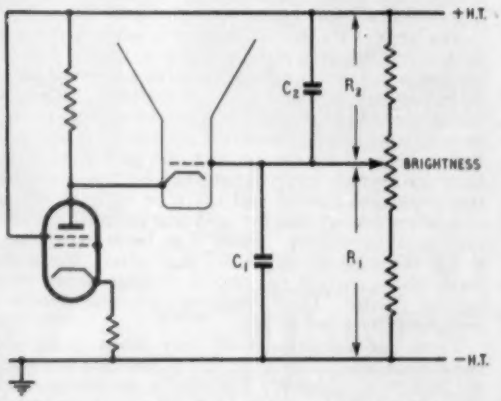
In the figure, therefore, the cathode of the tube falls to earth potential in not less than one second after the set is switched off. If C_1 only is present, the grid voltage cannot fall to earth as quickly because it is taken from the h.t. supply through a circuit of time constant $T=C_1R_1R_2/(R_1+R_2)$. If this time constant is comparable in value with, or larger than, the time constant of the h.t. supply, the grid voltage will lag behind the cathode voltage by a considerable amount, with the result that the grid-cathode voltage will be less negative than during normal operation. Theoretically, the grid might become positive to the cathode, with quite bad effects on the life of the tube. If it were possible for the h.t. voltage to drop instantly to zero, this would always happen, for the cathode would drop to earth while the grid would be held at its normal value by the charge on C_1.

It is because of this that it is often recommended that the brightness control should be turned right down before switching off. It is not, however, always a necessary safety precaution because there is still no risk if the time constant T is small compared with the h.t. time constant. The two voltages will then fall with substantially the same time constant, and the grid-circuit time constant will have negligible effect.

The grid is often at about 50 V above earth in normal operation. For a 250-V supply R_1 might be $10\,k\Omega$ and R_2 $40\,k\Omega$. With 0.1 μF for C_1, the time constant is

$$T=10^{-7}\times8000=8\times10^{-4}\text{ sec}$$

This is very small compared with the 0.3 sec of the h.t. supply and would still be small even if it were ten times as great. There is thus very little risk with



The bypass capacitors C_1 and C_2 are not usually both employed together. One of them only is used.

the normal values of components, and it is not usually necessary to turn down brightness before switching off.

In the alternative position for the capacitor, using C_2 instead of C_1, there is no possibility of the grid becoming positive to the cathode whatever the values of the time constants. If the h.t. voltage could drop instantaneously to zero, so that the cathode could drop at once to earth, the grid voltage would change negatively by an equal amount and the grid-cathode voltage would be unchanged. The charge on C_2 would be unaltered and so the grid voltage relative to plus h.t. would be unaltered but, as plus h.t. would have dropped to earth, the grid would have dropped below earth.

The use of C_2 is inherently safe under all conditions on switching off. The use of C_1 is, in normal practice, also safe, but could be unsafe if the relevant time constants were very unusual.

It is now necessary to consider what happens when switching on. There are two distinct possibilities to take into account. What happens depends on whether the video stage and tube become operative before or after the h.t. voltage is applied.

The first condition is obtained when an indirectly-heated rectifier is used and its warming-up period is, as it should be, longer than that of the valve and tube. The rise of h.t. voltage depends not only on the electrical time constant of the h.t. supply circuits but also on the rectifier valve itself. The rise usually takes several seconds, as anyone may see for himself, by watching a voltmeter connected across the h.t. supply. The needle takes several seconds to reach its final value. The tube cathode rises with the h.t. and at the same rate.

Using C_1 only, the grid potential rises also, but, because of the time constant T, it lags somewhat on the h.t. voltage. The grid is more negative to cathode than normal, and this is a completely safe condition whatever the time constants.

With C_2 only, the conditions are reversed; C_2 charges from the rising h.t. voltage and the voltage across it lags on the h.t. voltage. The grid voltage relative to cathode is thus somewhat less negative than it should be. It is necessary, therefore, to have the time constant small compared with that of the h.t. supply for the condition to be a safe one. The conditions are much the same as on switching off using C_1, and so normal component values are safe ones.

The second h.t. condition occurs when a directly-heated rectifier or a metal rectifier is used. The h.t. voltage is then at its normal value, or somewhat above it, before the valve and tube are operative. No harm will come to the tube even if, while its cathode is cold, its grid is momentarily carried positive to its cathode. Before valve and tube function, the grid voltage will have its normal value determined by the setting of the brightness control and the tube cathode will be at positive h.t., so that the grid will be more negative than usual to cathode. There is no harm in this, even if the tube warms up before the valve. When the valve draws current the cathode voltage drops to its normal value. This condition is consequently a completely safe one.

There are two conditions only when there is a theoretical possibility of the grid of the tube becoming positive to its cathode. The first is on switching off when C_1 is used, and this can be obviated completely by turning down the brightness control before switching off. The second is on switching on when C_2 is used and the h.t. supply contains an indirectly-heated rectifier.

However, provided that the time constant of the grid circuit of the tube is much smaller than that of the h.t. supply, all the conditions are adequately safe in practice. It is not necessary even to turn down the brightness control before switching off; that is, as far as the grid-cathode conditions are concerned. If the e.h.t. circuit has a time constant long compared with that of the h.t. supply, it may be advisable to do so to minimize any risk of the screen being burnt.

One other thing: if the set is switched off and then on again within a few seconds a dangerous condition can occur, for all valve heaters will still be hot and the switching-on conditions will not be the normal ones. There is no risk with C_1 but there is a slight one with C_2. With the h.t. rectifier hot, the rise of h.t. voltage will be more rapid than the decay on switching off and the effective h.t.-circuit time constant may no longer be large enough compared with the time constant of the grid circuit of the tube for the conditions to be completely safe.

It will be clear, therefore, that it is normally safe to use the grid bypass capacitor in either position. There is a slight preference for using it in the C_1 position, which is the usual one, but it is very slight.

Manufacturers' Literature

Underwater Television Equipment with image orthicon camera capable of operating at a depth of 1,200ft and with remotely controlled optical focusing. Descriptive leaflet from Pye, Ltd., Radio Works, Cambridge.

Negative-resistance Elements ("Brimistors") for suppressing surges and compensating resistance variations. Data booklet with list of types and characteristic curves from Standard Telephones and Cables, Footscray, Kent.

Wire-wound Potentiometers in values up to 25kΩ linear and rated at 2 watts. Leaflet from A.B. Metal Products, 16, Berkeley Street, London, W.1.

Precision Castings and Fine Tubing in nickel alloys. Manufacturing processes and applications described in an illustrated booklet from Henry Wiggin and Company, Wiggin Street, Birmingham, 16.

Vitreous Enamelled Resistors, using nickel alloy wire, with values from 9kΩ to 100Ω, ratings up to 180 watts and tolerances of ±5%. Data booklet from the distributors, Radelec, Ltd., 63, High Street, Cheltenham.

Flat Twin Transmission Lines with impedances from 75Ω to 300Ω. Leaflet giving characteristics at 1 and 100 Mc/s and at amateur transmission frequencies. From The Telegraph Construction and Maintenance Company, Telcon Works, Greenwich, London, S.E.10.

Helical and Toroidal Potentiometers; a comprehensive illustrated catalogue giving specifications and constructional details from P. X. Fox, Hawksworth Road, Horsforth, Yorks.

Amplifying Telephone Sets with m.c. microphone in handset and battery-powered amplifiers for transmission and reception in the base of the instrument. Technical description on a leaflet from Lustraphone, St. George's Works, Regents Park Road, London, N.W.1.

Sub-miniature Electrolytics measuring ¾in long by ¼in diameter with values up to 8μF and working voltages up to 50V. Technical bulletin from The Telegraph Condenser Company (Radio Division), North Acton, London, W.3.

"Ferroxcube," an informative booklet on this material, including an historical survey, details of physical structure, electrical and magnetic properties, mechanical features, application data and standard core dimensions. From Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

Components and Accessories, a comprehensive illustrated catalogue for mail orders from the Radio Servicing Company, 82, South Ealing Road, London, W.5.

F. M. Feeder Unit, a leaflet describing a unit (or kit of parts) made according to the design by Amos and Johnstone in our September and October, 1952, issues. From Bel Sound Products Co., Marlborough Yard, London, N.19.

Manufacturers' Products

NEW EQUIPMENT AND ACCESSORIES FOR RADIO AND ELECTRONICS

New Television Aerials

TWO new models and a refinement to an existing one comprise the latest additions to the range of television aerials made by Antiference, Ltd., 67, Bryanston Street, London, W.1.

One new model is a wall-mounting dipole incorporating the quick-assembly feature described as "snap-acitor" fitting. It is pre-assembled at the factory, but its main feature is that the feeder is capacitance-coupled, not directly connected, to the dipole. It is an addition to the existing wall-dipole and can be used either vertical or horizontal. The price is 27s 6d complete.

The other new model is a horizontal "Antex," or "X," aerial fitted on a swan-neck mast. It is available with chimney stack lashings, Model X4L/H costing 70s, or for wall-mounting, Model X4W/H, at 61s 6d.

Antiference horizontal "Antex" television aerial now available on a swan-neck mast for chimney or wall mounting.

The refinement is incorporated in the new "Univex" indoor aerial, the two telescopic tube sections now being enclosed in cream coloured PVC to tone with the centre insulator. Known as Model U2RC, it costs 21s with 15 ft of cream coloured coaxial cable, or 15s without.

Pickup Arm

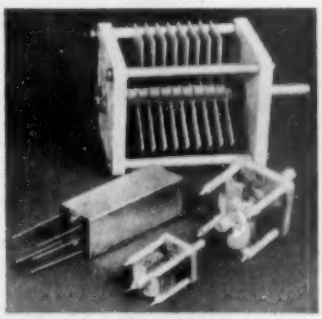
A KIT of parts is now available for a tone arm to match the moving-coil pickup designed by A. M. Pollock for home construction. The outfit comprises a simple, but effective, pivot post with hardened bearing point, a box-section laminated plastic arm, a bearing spindle for the vertical motion and a lead counterweight. The user is called upon to drill and file out a slot in the arm, drill and tap the lead weight and mark out, drill and reamer the holes for the horizontal bearing, operations which call for reasonable skill in the use of hand tools. The price of this kit, which is obtainable from A. M. Pollock, 14, Broomfield Lane, Hale, Cheshire, is 26s by post.

H.F. and V.H.F. Components

A NUMBER of new Eddystone components for short- and very short-wave receivers and transmitters have been introduced by Stratton and Co., Ltd., Alvechurch Road, West Heath, Birmingham, and, together with existing items, will be included in a new catalogue shortly to be issued.

Among the new items is a series of transmitting capacitors in split-stator, differential and plain types ranging from 25+25 pF to 250 pF. The specimen shown here is a 100-pF size with vane spacing of 0.08 in and it will stand up to the highest r.f. voltages likely to be encountered in small transmitters provided the d.c. is applied through a parallel path. End plates are ceramic 2½ in square.

In contrast to the above is a new miniature Microdenser in butterfly, split-stator and plain types. A single ceramic back plate measuring ¼ in square is used. The capacitances are 25+25 pF or 50 pF according to type. For comparison of sizes we include in the illustration one of the normal Microdensers of 15+15 pF in split-stator style mounted on a ceramic end-plate 1.3 in square. All metal parts in Eddystone capacitors are heavily silver plated.



Selection of new Eddystone components, comprising 100-pF transmitting capacitor, standard and new miniature Microdensers and 5.2-Mc/s discriminator transformer.

Of interest to builders of f.m. receivers is a range of 5.2-Mc/s i.f. units in small metal cans 0.8 in square and 2.4 in high. Included are discriminator and plain i.f. transformers and a BFO unit.

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RANDOM RADIATIONS

By "DIALLIST"

Taxi!

MY RECENT mention of the intrusion into a tape recording of a message from a radio-taxi to its headquarters brought me a large number of letters from readers, to whom I am most grateful. They gave instances of break-through from taxis, police cars, walkie-talkies, fire brigade radio-links and amateur transmitting stations into not only tape recorders, but p.a. systems, TV sound stages and even baby alarms! As many of my correspondents point out, there must be pick-up by some lead, which happens to be of just the right length, and rectification. The latter process could take place in a variety of ways; a "dry" soldered joint or a poor switch contact are examples of possible adventitious metal rectifiers. And an amplifying valve will function as a rectifier of sorts if it is overloaded by a signal of large amplitude. I gather there have been some rather embarrassing incidents with p.a. systems when the loudspeakers blared forth for all and sundry to hear remarks very definitely not intended for public consumption.

Shooting a Line

ONE HEARS various explanations offered for the occurrence of a narrow white vertical line near the left edge of the television screen when some cameras are in use. Well, here's the truth straight from the horse's mouth—though I hope my B.B.C. informant won't think I'm calling him a horse! There is an overshoot in the trailing edge of the line sync pulse; rising from blacker-than-black, it doesn't stop at the black level, but goes up as a little "pip" well into the greys. The effect is more marked in some cameras than in others and it is apt to be accentuated when the signal travels over a long network. The B.B.C. is doing its utmost to reduce the overshoot; but some of the receivers of to-day don't make things too easy for them. If the line flyback is rapid, the overshoot has no visible effect, for the white line that would be due to it is pushed right off the screen. With slow flyback it is apt to come in as an unwelcome addition to what is otherwise a good picture. And so, for the time being, at any rate, those whose receivers are designed in that way must regard the white line as just one of those things.

Counsels of Perfection?

IT IS, I suppose, to the demand for cheaper and cheaper television receivers that the present trend towards the live-chassis design for sets of all kinds is mainly due. Strict as the B.S.I. requirements are, I can't say that I'm altogether easy about the position. BS415 lays down that all openings in a television cabinet must be of such size and shape that the "standard finger" can't be pushed through any of them dangerously near to any live part. This gadget has joints, which can be locked or left free to move, and represents a long, thin human finger. In other words, everything seems perfectly safe, so long as the back stays put. But, the television receiver has become so much a part of domestic equipment that it is not unusual for quite small children to be left by themselves watching Muffin the Mule or the Flowerpot Men. The B.S. test equipment doesn't, so far as I know, include a standard metal knitting needle—and that was the prodder used by one youngster, of whose exploit I heard recently. At his age, I'd have been very tempted to do the same. He was not hurt, but his dropping the needle into the set and his mamma's subsequent stout work with the fire extinguisher made a pretty expensive mess of things. My suggestion, for what it is worth, is that all six walls of the cabinet of a live-chassis receiver should be lined with metal gauze, bonded and earthed. I'd like, too, to see an arrangement which switched off the set when the back was removed. I'm all for having two capacitors in series (and not just a single capacitor) between set and dipole. And, lastly, I *would* like to see a complete prohibition of the use of eighth-watt resistors in most parts of a TV receiver.

Fitting 'Em In

THE URGE felt by so many to buy television sets with larger and larger c.r. tubes is a curious one, considering the small living rooms of modern houses. You murmur the expected words of polite admiration when friends proudly show you their umpteen-inch set; but when the monster is switched on you may find that, even if you jam the back of your head tight against the opposite wall, you can't get far enough from the screen to see the picture properly. I'm speaking, needless to say, of receivers that do not employ either spot-wobble or spot-elongation. Given either of those—spot-wobble for choice—a big-tube receiver can give a good account of itself in a small room. Without them you must

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in such circumstances strain your eyes by looking at a liney picture, in which every small imperfection is all too obvious. A good rule of thumb is that the room must be at least as many feet one way as there are inches across the receiver screen.

That Awkward Question

MANY READERS must suffer as often as I do from one of the most embarrassing of all requests for advice: "I want to buy a television set, but I don't know the first thing about them. Be a good chap and tell me which is the best to get." Years ago I made a firm resolution that I'd never again recommend anything to anybody! There's always the risk, for one thing, that if you do recommend a particular this or that, the man who takes your advice may be landed with the one and only dud in the history of the firm that made it. But when it comes to television sets there's a much more important consideration than that: when a man buys one of them he also, so to speak, buys the dealer with it. The best of sets can be badly handicapped, if it is installed and maintained by a not very skilled, and perhaps not very enthusiastic, serviceman. Most of the dealers whom I know are good; but there is the odd black sheep.

At It Even Then

A FRIEND SENT ME the other day a copy of a now almost forgotten wireless periodical, which he had found while rummaging amongst some old papers. The issue bore a date early in 1936 and I was interested to find that it contained an article from my pen, forecasting the havoc that motor-car ignition interference would play with television, unless something were done quickly about it. What a difference there would be to-day, had an act been passed those eighteen years ago to compel manufacturers to provide all new cars with suppressors! Interfering vehicles would now be few and far between; and when a "snowstorm" did break out on the screen we'd have the comforting thought that the veteran causing it wouldn't be on the road much longer. I believe that the only country which did outlaw interference radiators of all kinds was Germany. It was not television that its then rulers had in mind: they were out to ensure that the working of v.h.f. apparatus used by their army and air force should not be upset. If, though, the law has remained in force, German viewers must be reaping the benefit.

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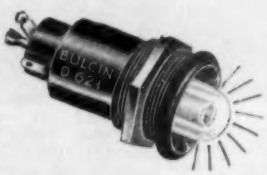

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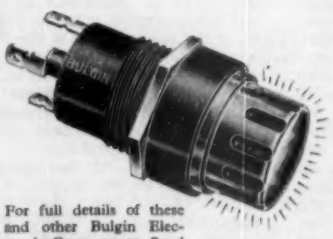

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UNBIASED | By FREE GRID

Aesthetics and Anæsthetics

JUST LATELY the newspapers seem to be full of the wonders that we are to see on our TV screens in a few years' time when the B.B.C. and the proposed rival corporation are locked together in the fierce struggle of competition. One thing that I am glad to see is that programmes from the proposed new corporation's transmitters are to be strictly controlled and there will be no need to send the children out of the room when we switch on the TV set, a thing which I have frequently had occasion to do when carrying out experimental work on the reception of a certain Continental station.

"Peeping at his pancreas."

Despite the promise of strict programme control, there is some danger that in years to come something not suitable for children—nor yet for adults—may be televised; this was brought home to me very forcibly recently when talking with a country doctor living in a remote district amid the Cymric Hills. He pointed out to me that, by comparison with medicos living on the doorstep of a hospital, he and others similarly situated had fewer facilities for keeping in active touch with the latest surgical developments. Yet, of course, they really had more need of them, for they frequently had to cope with sudden surgical emergencies themselves as there was no nearby hospital to which they can send the patient.

He is, therefore, eagerly hoping that the Ministry of Health will buy time from the proposed corporation and give TV broadcasts, straight from the operating theatre, of front-rank surgeons employing the latest techniques. Now this seems at first sight to be a very desirable development, but, to say the least, these anæsthetic presentations would be unæsthetic. Speaking personally, I have no desire at some future date for my midriff to be exposed to the morbid-minded mob or my ribs to the ribaldry of the rabble.

Surely, no man in his right senses wants to have the public peeping at his pancreas or leering at his liver; I hope, therefore, you will all join with me in demanding, before it is too late that such "programmes," if televised, should be thoroughly scrambled and the necessary de-scrambling apparatus supplied only to doctors and medical students.

Coherers in 1908?

LIKE THOSE of you who have been readers from the first number of *W.W.* and experimenters for a long time before that, I have during the course of years accumulated a considerable amount of wireless apparatus. From time to time Mrs. Free Grid has made an onslaught upon it and made a bonfire of all that she could lay hands on. There has, however, always been a considerable residue in the hinterland of the loft which she has been unable to reach owing to the suspected presence of woman's natural enemy, the mouse.

It is more years than I care to remember since I previously penetrated the jungle of disused household paraphernalia up there, but I recently did so in an endeavour to find an old newspaper to settle an argument as to the precise date of the relief of Mafeking.

I was astonished at the wealth of early and primitive wireless gear I found, but the most interesting was a coherer-decoherer unit in a remarkably good state of preservation. I have not the slightest recollection of acquiring the instrument and I find it very difficult to assign a date to it. I am hoping that some of you with long memories will be able to help me from the few details I give.

It is not an experimental instrument made by an amateur, nor yet a commercial one of the type used by ship and shore stations in the early days of wireless. The familiar D.R.G.M. marking on it leaves me in no doubt of its origin and I should say it was imported from Germany for sale to amateurs.

At first I thought it might have been sold by one of the big departmental stores, but I find that none of them started a wireless department until 1908 and surely that was too late for coherers? These primitive receivers started to disappear from commercial W/T stations soon after the arrival in 1902 of the magnetic detector, but these were expensive and massive devices and maybe coherers did linger on in amateur circles until the close of the Edwardian era. If so, possibly some of you will recognize the unit from my photograph. The instrument by the side of the coherer is a relay, presumably for working a morse inker for which two terminals marked M are provided. There are terminals at each end of the coherer for aerial and earth and two pairs marked + and − for batteries.

"That's Champion!"

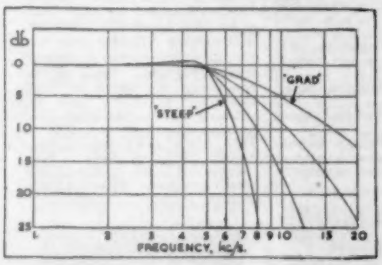
DESPITE all the propaganda I don't think the majority of motorists fit suppressors to their plugs to stop interference to TV. In the early days of television we used to hear about the detrimental effect which suppressors were supposed to have on engine performance. This was disproved so thoroughly that the argument is seldom heard now. I am afraid that nowadays offenders simply take the couldn't-care-less attitude. A move in the right direction has, however, been made by a well-known maker of sparking plugs who supplies them with built-in suppressors. "That's champion!" as a Lancashire man might say, and I only hope the other plug-makers will follow suit and that eventually no maker will produce a plug without a built-in suppressor.

Primitive wireless receiver.

LEAK *equipment is* ***unique***—

It is acceptable to professional communications engineers for recording and broadcasting. The B.B.C. use several hundreds of the TL/12 Amplifier, and 1,000 are used by other Broadcasting Corporations.

The Vari-Slope



Frequency amplitude curves for the "TREBLE-3" position (5 kc/s turn-over). Curves of the same slopes are obtained on the other two positions turning over at 7Kc/s and 9Kc/s ("—2" and "—1" positions).

Representing a unique feedback circuit development, the "Vari-Slope" pre-amplifier gives audibly better reproduction. This advance consists of variable slope "electronic" low-pass filters operating on negative voltage feedback principles. No Inductors ("Chokes") are used, and their disadvantages are completely eliminated. The turnover frequencies are 5kc/s, 7kc/s, and 9kc/s, and the slopes of attenuation are continuously variable over the range 5db to 50db per octave.

The filters consist essentially of Twin-T resistor-capacity networks inserted in the return circuit of a single-loop feedback amplifier. The more obvious advantages of this electronic feedback method over conventional choke filters include :—

(a) Improved transient response characteristics (due to absence of chokes having self-capacitance) and the consequent reduction of "ringing."
(b) Extremely low harmonic and intermodulation distortion due to negative voltage feedback action.
(c) No discontinuities in the rates of slope when the slope control is operated, and no change in signal level at frequencies below turnover (Both these faults occur in variable-slope choke filters due to the slope control altering the terminating impedance and the insertion loss.)
(d) No chokes to cause magnetic hum pickup.
(e) Smaller size, lighter weight, greater uniformity in production.

LIST PRICE IN BRITAIN **12 Gns.**

Point-One TL/12

Triple Loop Feedback Amplifier

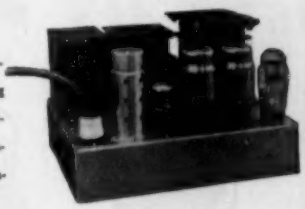
Used with the "Vari-Slope" pre-amplifier and the best available complementary equipment, the TL/12 power amplifier gives to the music-lover a quality of reproduction unsurpassed by any equipment at any price.

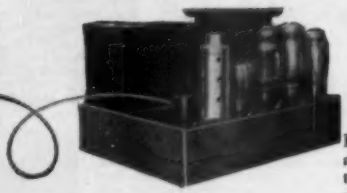
For laboratory use as a stabilised-gain audio frequency power amplifier. For the highest possible standard of disc recording. For the highest possible quality of reproduction from Pickup, Radio, Microphone, Film and Magnetic Tape. For use as a driver amplifier in the speech modulator chain of broadcast transmitters.

27 Gns.

The "Point-One" TL/12 Amplifier is built to a tropical specification and used throughout the world, including:

The British Broadcasting Corporation.
The South African Broadcasting Corporation.
The Swedish Broadcasting Corporation.
The Swiss Broadcasting Corporation.
The Italian Broadcasting Corporation.





Steep-Cutting Filter

For use with the TL/12 power amplifier and pre-amplifiers preceding the Vari-Slope. This filter unit is of particular interest to the record enthusiast.

£5. 10s.

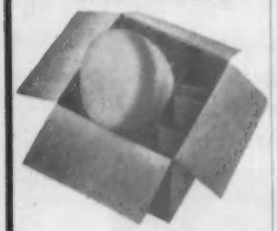
Write for fully descriptive literature.

H. J. LEAK & CO., LTD., BRUNEL ROAD. WESTWAY FACTORY ESTATE, ACTON, W.3

Phone : SHEpherds Bush 1173/4. Telegrams : Sinusoidal, Ealux, London. Cables : Sinusoidal, London.

ELECTRONIC PRECISION EQUIPMENT LTD.

LAST FEW



15in. MAGNETIC TELEVISION TUBE

By famous maker. Specification Blue/White screen 9 Kv. ion trap triode, heater 6.3 v. at .55 amp., 50° deflection. New, with written guarantee, offered at approximately half price, £13/10/- each, plus 10/- carriage and insurance. H.P. terms £4/10/- deposit and 12 monthly payments of 18/3. Limited quantity, so order immediately.

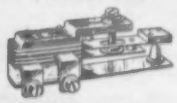
CARBON RESISTORS

These will now be supplied in individual packets, with the value and wattage clearly indicated.

Prices :

½-watt, 5d. each ; 1 watt, 6d. each.

NEW 5 AMP. THERMOSTAT (MINIATURE)



2½" × 1" × 1½" high

Useful for the control of appliances such as convectors, gluepots, vulcanisers, hot plates, etc. This thermostat is adjustable to operate over the temperature range 50-550 deg. F., fitted with heavy (5 amp. A.C.) silver contacts size 1½in. long × ½in. wide, price 8/6, post 6d. ; 1 amp. type, 3/6, 2 amp. type, 5/6.

4in. NAVIGATION COMPASS

Sturdy and reliable. Floating dial, shock mounted in metal case. All cardinal points and degrees marked. Each compass in wooden box. Exceptionally low price. 20/-, plus 2/- postage.

TWO-VOLT ACCUMULATORS

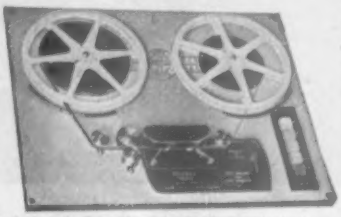
Made for the Forces by one of the most famous firms in the world. 15 amp.-hour size approx. 6in. × 1¾in. square in ebonite case, pre-charged, only need filling with acid, 4/9 each, plus 9d. post and insurance.

THE ELPREQ "SELECTIVE FEED-BACK" AMPLIFIER

The amplifier is fitted with independent bass and treble control, both connected through different feed-back loops so that no "cut" at all in the ordinary sense is applied. The variation which can be achieved by applying various degrees of negative feedback in the higher and lower ranges of the sound strata will accommodate all individual tastes.

We strongly recommend a 12in. speaker in order to make the fullest use of the instrument's potentialities. Booklet and set of componenets available at once at £2/19/6, post, etc., 2/6. Booklet separate 1/6. 12in. speaker to suit £3, post free if bought with amplifier.

TRUVOX TAPE DECK



Yours for £7/14/- Now available ex-stock, this fine tape deck has many superior features some of which are as follows :

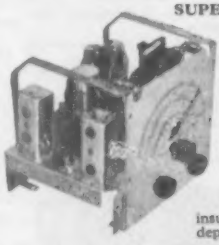
1. Powered by 3 shaded-pole A.C. motors.
2. "Drop-in" Tape loading.
3. Push-button control, electrically and mechanically interlocked.
4. Separate push-button brake. Patented electric type.
5. "Fast-forward" and "fast-rewind" without tape wear, one minute for a full reel.
6. Silent drive eliminating "wow" and flutter.
7. Half-track working, and two Tape speeds giving 60 minutes each track at 3¾in. per second or 30 minutes each track at 7½in. per second.
8. Visual playing-time indicator.
9. With a suitable amplifier, the equipment covers a frequency range from 50-10,000 c.p.s. at 7½in. per second.
10. The deck will take all standard reels, plastic or paper-based tapes, up to 1,200ft. capacity.

We have a good stock and will be pleased to supply. Price is 22 gns. or if you wish send only £7/14/- deposit, the balance can be spread over 12 months. Non callers please add 7/6 carriage and insurance.

A Happy New Year to you all

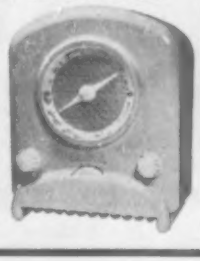
We take this opportunity to wish you Good Luck and Good Health. May 1954 be your best year yet.

SUPERHET RADIO BY BEETHOVEN



Extremely well built on chassis size approx. 9½ × 7½ × 8½ using only first class components, fully aligned and tested, 110-240 volt A.C. mains operation. Large clear edge-lit dial. Three wave bands covering 200-550, 35-120, 13-42 metres. Complete with five Mullard valves, frequency changer, double diode triode, pentode output and full wave rectifier. Complete with Rola loudspeaker ready to operate. Special cash with order price this month, £7/17/6, carriage and insurance 7/6. Hire purchase terms £3 deposit, balance over 12 months.

BEDROOM-NURSERY MAINS MIDGET RADIO



All the parts, bakelite cabinet, valves, knobs, back—in fact everything will cost you only £3/15/- (plus 2/6 postage) which, we think you will agree, is not too much to spend on your dear ones. The set is economical to run, too, for it uses only three valves in a special reflex T.R.F. circuit which gives ample power combined with good tone. Incidentally if you wish to give the sets to young children why not decorate the cabinet with a few suitable transfers ? These can usually be obtained from local handicraft shops. Circuiting and construction data free with the parts or available separately at 1/6.

NUTS, BOLTS AND WASHERS

6 B.A. BRASS FULL NUTS	2/-	per gross
4 B.A. " "	3/-	" "
6 B.A. ½in. Brass Bolts ..	2/9	" "
6 B.A. ¾in. " " ..	3/3	" "
4 B.A. ½in. " " ..	3/6	" "
4 B.A. ¾in. " " ..	4/3	" "
6 B.A. ½in. Steel " ..	1/6	" "
6 B.A. ¾in. " " ..	1/9	" "
4 B.A. ½in. " " ..	1/9	" "
4 B.A. ¾in. " " ..	2/-	" "
4 B.A. 1in. " " ..	2/9	" "
6 B.A. Brass Washers	2/-	" "
4 B.A. " "	2/6	" "
6 B.A. Steel "	1/3	" "
4 B.A. " "	1/6	" "

SPECIAL OFFER—SERVICEMAN'S ASSORTMENT, containing 3 gross of mixed popular sizes as above, 4/6.

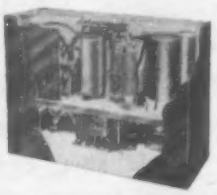
SILVER MICA CONDENSERS, all sizes from 5 pf. upwards, 6d. each or 100 assorted, 30/-.

60-WATT VARIABLE RESISTORS, blank formers—wind on your own resistance wire—screw adjustment so Vernier control possible, 9/6 each, £5 doz.

12-WAY TELEPHONE SWITCHBOARDS. These are ex-M.O.S. stock, but are brand new and unused. Price £20 each.

4-WAY TELEPHONE SWITCHBOARDS. These are for use with the Royal Navy SOUND POWERED TELEPHONES which we sell. Only a small quantity are available. The price is £12/10/- each.

2-CIRCUIT TELEPHONE AMPLIFIERS. These are for amplifying the signal in both directions of traffic and for reducing distortion over long distance—Service No. YV/YA 3757. These are unused but many require attention, due to long storage. Circuit diagrams and details available. Price £12/10/- each.



VIBRATOR UNIT

This unit gives 150 v. at 50 mA. from 4 or 6 v. car battery, also gives L.T. supply, suitable for all dry valves. 1T4, 1R5, etc. Ex-W.D. Price 15/-, plus 2/6 post.

HEADPHONES, lightweight American make, type HS30, 27/6 pair. British made types : high resistance, 14/6, low resistance, 6/6.

40 VOLT 2½ AMP STEP DOWN TRANSFORMER Totally enclosed in metal box—primary 200-240 50 c.p.s. ; secondary easily rewindable to other voltages—ideal safety unit for operating children's toys or domestic gadgets, 17/6 each.

2-VOLT WET CELLS, lead acid type, in small glass jars. Make up your own wet L.T. 2/6 per cell, post 6d. per cell.

CRYSTAL OVENS. Mains operated, thermostatically controlled, new and unused, £2/10/- each. Few only.

MAINS OPERATED BELLS. Use these in connection with our low-priced thermostat and you can make a frost- or fire-alarm for less than 10/-. Plenty of other uses. Price only 5/6 each.

ELECTRONIC PRECISION EQUIPMENT LTD.

NEW ITEMS THIS MONTH

PROJECTION T.V. SCREEN

Made from plastic and precision-milled on both sides to give a reflectionless surface. The cost of these from the manufacturers was 30/- each, but through a company going into liquidation we are able to offer these at 17/6 each. Size is 17 × 14in. but easily cut to suit cabinet opening. A limited quantity only, of course, is available.

PLASTIC TELEVISION MASK

This is a Mask and Implosion Guard combined, made for 12in. tube from moulded perspex and internally sprayed bronze. It is the type of mask which fixes on the inside of the cabinet and is thus suitable for the amateur-cut hole. It is the latest type of mask as fitted to most modern televisors. Brand new and perfect at less than manufacturer's price, viz. 15/-, plus 1/6 carriage and insurance.

BALL BEARING TURNTABLE

As fitted to portable radios. The diameter approximately 4½in. Price 2/6 each.

NEEDLE CUPS

For gramophones made from Bakelite. Diameter approximately 1½in. Price 6d. each, or 4/6 a dozen.

BLACK SEALING WAX

For filling grubb screw holes in Bakelite, knobs, sealing instruments, etc.: ½lb. sticks 1/6 each, or 15/- a dozen.

BLOCK CONDENSERS

.5 mfd., 1,000 volts, 2/6. .5 mfd., 750 volts, 2/-. 2 mfd., 400 volts 2/6. 2 mfd., 350 volts, 2/-.

CLEAR PLASTIC PANELS

Suitable as windows in radio sets and instruments, size 4, 2½d. each; 5, 6d. each; 5/- a dozen.

CROCODILE CLIPS

Large size for battery charges. 9d. each, 7/6 a dozen.

SCREENED SYSTOFLEX

5 mm., 1/- per yard length 10/- a dozen yards

DOMED FEET

Nickel plated, knock-in type for wooden cabinets. 6d. each, 5/- a dozen.

NIPHAM PLUG

2-pin type No. XB.10260, 2/3.

MAZAK PLUGS AND SOCKETS

2-pin plug type No. 10H/1411, and socket to match, type No. 10H/397, 3/6 the pair. 19-pin plug, Type No. 10H/418, 2/6.

BAKELITE PLUG AND SOCKET

3-pin heavy duty type No. ZA/6557, with a socket to match. Type No. ZA/5585. 3/- pair.

SYSTOFLEX, ETC.

Insulated sleeving for all purposes. 24 1-yard lengths, mixed sizes 2-10 mm. Some varnished cotton (Systoflex), some P.V.C. for E.H.T. work. Approximate cost value 15/-, offered as a parcel 7/6, or half the quantity, 4/-.

THIS MONTH'S SNIP

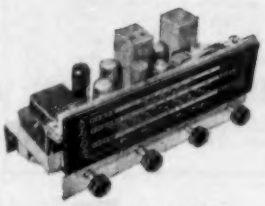
A 70 Gn. RADIOGRAM FOR ONLY 40 Gns.

OR £14. 0. 0. DEPOSIT

This Cabinet has all the properties which combine to make it a beautiful piece of furniture and yet a most up-to-date radiogram. Externally, it is beautifully figured walnut; internally, it is white sycamore. The radio section is raised to a comfortable operating level and beyond the auto changer is a compartment for storing your most popular records. We are most proud to offer this cabinet and feel sure that every purchaser will be equally proud to own one. It can be supplied complete as a working radiogram, the price being £42, carriage and insurance £1. Alternatively, the cabinet may be purchased separately, price £18/18/-. Or with record changer, but uncut radio board, price £30. The radio chassis incorporated in the complete model is our popular 5-valve A.C. mains Superhet, covering 3-way bands (long, medium and short) and with volume and tone controls, multi-colour edge-lit dial, etc. The record changer incorporated in all models is the latest Collaro 3-speed model (type No. RC531) with the famous Collaro "Studio" pick-up.

A FEW REMAIN

This cabinet is offered below cost. It is suitable for a televisor using tube sizes varying from 12in. to 17in., its overall dimensions being 3ft. 5in. high, 1ft. 4in. deep, 1ft. 10in. wide. It is complete with plywood back and "Bowler Hat." Originally made for a very expansive televisor and really good quality. Unrepeatable. Offered at £6/19/6, carriage, packing etc., 12/6. **Note:** These are cut for 12in. tubes, but the holes for the controls are not drilled.

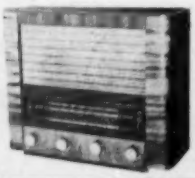


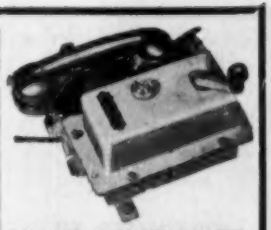
THE "WINDSOR" 5

This is a 5-valve A.C. superhet covering the usual long, medium and short wavebands. It has a particularly fine clear dial with an extra long pointer travel. The latest type loctal valves are used and the chassis is complete and ready to operate. Chassis size 15in. × 6in. × 6in. Price £9/19/6 complete with 8in. speaker. Carriage and insurance 10/-. H.P. terms £3/7/- deposit.

TABLE RADIO CABINET

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 16 × 16 × 7—walnut veneered and satin finished. 37/6, carriage and packing 3/6.
Note. This cabinet is the correct one for the chassis above.





EX-ROYAL NAVY SOUND POWERED TELEPHONE

These require no batteries, and will go for long periods without attention. Complete with generator and sounder which gives a high pitched note, easily heard above any other noise. Also fitted with an indicator lamp which in quiet situations can be used instead of the sounder, or where several h'phones are used together will indicate which one is being called. Size 7½in. × 9in. × 7½in., wall mounting, designed for ships' use, but equally suitable for home, office, warehouse, factory, garage, etc. Price 57/6 each, plus 4/6 carriage.

MILLIBAR BARO-METER, 7/6

The heart of a barometer is a metal bellows which will expand and contract with the varying air pressure. The aircraft altimeter works on the same principle, a series of gears and lever amplifying the expansion and contraction of the bellows and so works the pointer. We can offer the ex-R.A.F. Sensitive Altimeter slightly faulty but containing the essential bellows, gears, wheels, etc., from which a good barometer can be made. Price only 7/6, plus 1/- post.

FULL PICTURE VCR97

We have had a new delivery of this now-famous electrostatic 6in. T.V. tube, these are not the cut-off type, and we guarantee a full picture, 42/6, carriage and insurance 5/-.

SPRING LOADED TERMINAL BLOCK

Fully insulated so is ideal for mains, terminal point fitted on bench of workshop or laboratory. Also suitable for temporary hook ups when testing components, etc., will save its cost the first week of use. Price 3/6.

PLUGS FOR MODERN VALVE HOLDERS

Each is fitted with a rubber shroud. For B7G button base and type 2 for B9A. Price 1/4 each, discounts for quantities.

Complete kit comprises Hi-craft 40 watt control unit starter lamp, lamp holders, clips and wiring diagram. Price, less tube, 22/6, plus 1/6 post. With tube, 30/-, plus 3/6 P.P. Tubes 7/6 each, carr. free, minimum quantity 6.

ELECTRONIC PRECISION EQUIPMENT LTD.

ADVANCE PUSH BUTTON SIGNAL GENERATORS

We have 12 only of the Advance model C.2 Signal Generator. This is a production type, push button controlled, which can be set for 12 spot frequencies between 50 Kc/s and 30 Mc/s. The instruments have been used but are in perfect working order and we offer them at half List price, namely £30.

MULTIMETER KIT

All the essential parts, including 2in. moving-coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick-on range indicator and full instructions for making are available as a kit price 15/-, plus 9d. post and packing.

HIGH VOLTAGE VALVE HOLDERS

For four or five pin valves. Price 2/9 each.

2½in. TUBE MOUNTING

This comprises metal cased moulded rubber tube mounting, front escutcheon, 4 screws and Perspex window with engraved cursor lines, 5/- complete.

V.C.R. 139

Tube base with mu-metal screen 4/6.

MU-METAL SHIELD

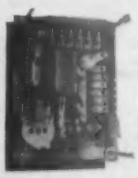
For 6in. tube V.C.R.97, etc., 10/- per pair.

6in. TUBE MOUNTING

Shock proof rubber mounted and adjustable, i.e., tube may be turned, with tube holder, 4/6 each

HIGH VOLTAGE

Insulated spindle couplers, 1/6 each.



AUTO-MATIC D.C. STARTER

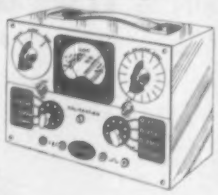
For remote control of D.C. motor between ¼ and 3 kw., adjustment for 100v. or 230 v. Unused and in first-class condition, complete with metal and wired glass cover. Price on request.

AMPLIFIER UNIT A 1134A

This is a 2-stage intercom and Tx pre-amplifier with transformers, etc. Easily modified as gram amplifier or dictaphone, etc. Complete with 2 2 v. valves, QPP and Triode. Price only 9/6, plus 1/6 post and packing. Circuit diagram, free with unit, or separately, 1/6.

THE 17 RANGE ELECTRONIC TEST METER

10 megohms input impedance on voltage ranges.



This is the first instrument of the new "Elpreq" range of test equipment. It is undoubtedly an essential piece of equipment for professional and amateur alike. It has all the qualities of a modern 20,000 ohms per voltmeter, with none of its fragility. It is quite as easy to handle as an ordinary instrument, yet it is a valve voltmeter which will enable you to measure directly, grid, A.V.C. and resonant voltages and to perform checking operations which extend its usefulness far above that of any ordinary multimeter.

By an ingenious piece of circuitry, exceptional accuracy is obtainable. The ranges include :—

D.C. Voltage ..... 4 Ranges
D.C. Current ..... 4 Ranges
A.C. Voltage ..... 4 Ranges
A.C. Current ..... 4 Ranges
Resistance Ranges.

For those interested in television, an optional E.H.T. probe extending the meter's range to 10KV is also available.

The instrument is completely self-contained and can be totally enclosed in an attractive metal case with carrying handle.

Price of completely self-contained instrument, less case 57/6. E.H.T. Probe 10/6. Case as illustration will be available shortly.

A RADIO UNIT FOR SUPERIOR 15

A circuit for a suitable radio unit to fit into our Coronation Console Cabinet has now been completed and thoroughly tested. All the parts are available. The total cost is £5/19/6. Data is included free with orders for parts, or can be supplied separately ; Price 2/6.

Note : This radio unit incorporates T.V. control and is also highly suitable for fitting into other televisors. The addition of a radio unit to a televisor is not only worthwhile, but is essential where the televisor is kept in a room away from the main radio.

The Corner Cabinet illustrated is also available now in light oak, or medium oak to suit your furnishings, and it really does look impressive. The price is £18, plus carriage. H.P. terms £6 deposit, balance over twelve months.

About the Superior 15 itself, if you have not already ordered your set of parts for this, be advised and do so immediately. We are definitely getting down to the last batch of the 15in. tubes and once these are gone the Superior 15 T.V. cannot be repeated. At £37/10/- for all the parts (including 15in. Cossor Tube) this represents the finest value ever offered to the home constructor. If you doubt your ability to make it then send 7/6 for the data and study this first. Don't forget, we guarantee to help you to get perfect results and, if necessary, for a nominal charge, will take in your televisor, completely check over your work, and return it to you in perfect order

BATTERY CHARGER KIT

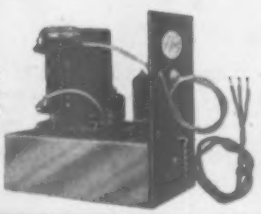
Suitable for six or twelve volt batteries. Kit comprises heavy duty transformer rectifier and two crocodile clips. 29/6 complete.

RINGING CHOKE E.H.T.

As described in last month's Wireless World.

This unit gives 2½ KV. and is highly suitable for working the Government Tubes VCR.97 etc. It will take the place of the E.H.T transformer and has the advantages not only of being very much cheaper but should anything break down then replacement parts cost very little. The construction of the unit is fully described in the December issue of the "Wireless World." We can offer a complete set of parts, including Valves SP.61 and VU.120, ½ meg. pot, ½ meg. resistor, .001 mfd. 3KV condenser, two valve holders, metal chassis and E.H.T. transformer from 1335 receiver. Price 16/- for the complete outfit.

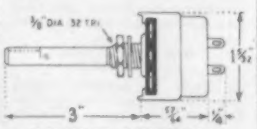
THE ELPREQ E.H.T. GENERATOR



This is a made up unit. Output obtainable ranges from 6 kv. to 9 kv. with normal H.T. rail input (6.3 L.T.) required. Dimensions are 6½ × 4½ × 7in. Price 69/6, post, packing etc., 5/-.

ELECTRONIC TIMER

With this instrument processes which operate over a specified time can be controlled automatically, e.g., in photography use it to control exposures, etc. The instrument can be set to any length of time from a fraction of a second up to three minutes, and it can be made to switch the appliance on or off. Circuit diagram and instructions, 2/3. Complete kit of parts, including valves, mains transformer, power pack, sensitive relay, potentiometer and metal case, 69/6.

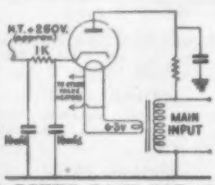


VOLUME CONTROLS

We carry a full range of standard-size volume controls from 2K to 2 meg. Prices are : less switch, 3/- ; Single pole switch, 4/- ; double pole switch, 5/-. We can also supply midget-type controls, less switch, 4/- ; single pole switch, 5/9 ; double pole switch, 6/6. Each of these midget controls has a serial number and carries a 12-month guarantee by the makers ; they are made on the new moulded track principle and really do perform well.

SHORT WAVE TUNING HEART

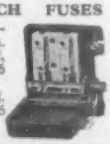
Coil Pack, 2 gang condenser, IF transformers and calibrated scale for frequency coverage of 13-37 metres, 37-100 metres and 200-500 metres. Price 39/6 complete with circuit diagram.



A POWER PACK FOR 15/-

Efficient power supply, O.K. for operating a receiver, amplifier, instrument or other device requiring up to 60 mA. at approx. 250 v. Parcel consists of filament transformer, rectifying valve, smoothing resistor and 16 × 16 mfd. 350 v. electrolytic condenser. Note the filament transformer will supply enough current to operate 3 or 4 other 6.3 valves.

M.E.M. SWITCH FUSES



10 amp. all Porcelain 250 v., 6/- each.
15 amp. Ironclad, 10/6 each, plus 1/6 post.
30 amp. Ironclad. 16/6 each. plus 2/6 post.

TOOLS, ETC.

"Q-MAX" CHASSIS CUTTERS.

The simplest and quickest tool for cutting holes in aluminium or steel chassis. Comprises die and punch operated by Allen key. A separate die and punch is required for each size.

⅜" hole (B7G, etc.)	11/6
½" hole (B8A, etc.)	11/6
⅝" hole	12/6

Same key fits these three, price 10d.

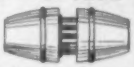
1" hole	14/9
1¼" hole (Octal base)	14/9
1¼" hole (English bases)	14/9
1½" hole	16/6
1¾" hole (EF50, etc.)	16/6
1⅞" hole	18/6
2 3/32" hole	30/-
2½" hole	35/-
1" × 1" square hole	23/-

Same key fits these nine, price 1/3.

METAL DIVIDERS.

Really well made for Government workshops. Ideal for marking out on metal chassis. Price 3/6.

MINIATURE 7-PIN PLUG AND SOCKET



With non-breakable plastic rubber shroud. Overall size 1⅛in. long, diameter approximately ⅞in. Price 2/- pair.

RUBBER GROMMETS.

⅜", ½", ⅞", 1d. each.
¾", 1", 1¼", 1½d. each.
Serviceman's packet of 24 assorted sizes, 2/-.

CROCODILE CLIPS

Small instrument, 6d. Large Car Battery type, 9d.

TERMINAL BLOCKS

Heavy duty type, 5 way 4in. long × 1in. wide × 1⅛in. high. 30 amp. rating. Price 1/6.
Heavy Duty type, 6 way porcelain 15 amp. rating. Price 1/6.
Heavy Duty type, 5 way porcelain 15 amp. rating. Price 1/3.
Heavy Duty type, 3 way porcelain 15 amp. rating. Price 9d.

PROJECTION T.V. CABINET

An impressive cabinet designed for projection T.V. but also very suitable for a good quality radiogram or amplifier. Size 23in. wide × 22in. deep, 37½in. high with lid closed. £8/15/0, plus 15/- carr.

SURPLUS BARGAIN CABINETS
for
RADIOS, TELEVISORS — TAPE RECORDERS — CLOCKS — RADIOGRAMS, ETC., are always on show at our three branches :—
E.C.4., FINSBURY PARK or RUISLIP.

LONG & MEDIUM WAVE OCCASIONAL RADIO

Yours for £2 . 1 . 6 (Deposit)

You will find that the building of our all-mains radio receivers is simplicity itself, and the more you make the less time each takes, everything down to the last nut and bolt is supplied, and everything fits together in a professional manner. When finished the receiver looks and plays as well as those being offered in radio shops at anything between £10 and £14. The one illustrated above we call the "Occasional," in a choice of colours, Ivory or Walnut and the T.R.F costs £6/1/6 to make, H.P. terms being £2/1/6 deposit and 10 monthly payments of 10/6.

AMPLIFIER RACK—SPECIAL LOW PRICE

This stands approximately 6ft. high, and was made originally for the G.P.O. The top panel contains the amplifier proper, which consists of an A.C. mains driven power pack, capable of delivery 200 mA. at 400 v. and, of course, the normal L.T. supplies and the amplifier itself uses an MHL4 feeder and two PX25s in the output stage, giving approximately 25 watts. This top deck also contains the heavy duty output transformer. The lower panel contains the feeder unit which can be used as a pre-amplifier for microphone and gramophone work. You will observe that on the rack there is ample space for fitting a monitor speaker and an R.F. unit if same are required. Note that the anode current of the PX25 valve is monitored by a 2½in. flush meter. Further note that these amplifiers were made by the famous MARCONI company. Complete as illustrated but less valves, unused and only very slightly storage soiled. Price £5/10/-, plus 12/6.

EXCEPTIONAL I.F. TRANSFORMERS

Ferro enclosed and cored, 465KC adjustable, very high Q and gain. Ideal for car radios, personnel sets, etc. Dimensions : 1⅛in. high × 1in. dia. Price 8/6 per pair.

EX-GOVT. VALVES

CV2654

CV1090

CV2579

CV12	CV1047
CV13	CV1051
CV18	CV1053
CV19	CV1054
CV20	CV1055
CV22	CV1056
CV31	CV1057
CV32	CV1060
CV37	CV1061
CV43	CV1061 A
CV45	CV1062
CV51	CV1065
CV53	CV1066
CV54	CV1074
CV56	CV1075
CV57	CV1078
CV63	CV1090
CV65	CV1091
CV67	CV1092
CV71	CV1094
CV72	CV1095
CV73	CV1101
CV74	CV1102
CV82	CV1104
CV85	CV1105
CV92	CV1106
CV93	CV1107
CV115	CV1108
CV117	CV1110
CV118	CV1111
CV120	CV1118
CV129	CV1120
CV133	CV1124
CV138	CV1125
CV147	CV1126
CV148	CV1127
CV158	CV1128
CV160	CV1129
CV177	CV1133
CV185	CV1135
CV187	CV1136
CV188	CV1137
CV193	CV1139
CV210	CV1141
CV271	CV1147
CV321	CV1152
CV327	CV1170
CV534	CV1175
CV594	CV1187
CV619	CV1191
CV621	CV1197
CV634	CV1199
CV640	CV1284
CV656	CV1300
CV659	CV1306
CV665	CV1310
CV668	CV1311
CV686	CV1366
CV702	CV1367
CV704	CV1368
CV755	CV1449
CV773	CV1481
CV779	CV1504
CV781	CV1508
CV849	CV1573
CV852	CV1653
CV895	CV1755
CV922	CV1913
CV1000	CV1943
CV1018	CV2539
CV1020	CV2579
CV1023	CV2679
CV1025	CV2710
CV1029	CV2941
CV1031	CV2945
CV1032	CV3581
CV1033	CV3793
CV1035	
CV1037	

ELECTRONIC PRECISION EQUIPMENT LTD.

Post orders should be addressed to :—

ELPREQ HOUSE (Ref 2.), HIGH STREET, WEALDSTONE, MIDDX.

Personal shoppers however must continue to call at :—

42-46, WINDMILL HILL, RUISLIP, MIDDX.
Phone : RUISLIP 5780. Half-day Wednesday.

152-153, FLEET STREET, E.C.4
Phone : CENTRAL 2833. Half-day Saturday.

29, STROUD GREEN RD., FINSBURY PARK.
Half-day Thursday.

Garrard

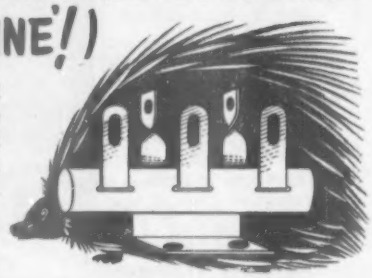
gramophone equipment is world famous for its reliability and its excellent design, and is acclaimed throughout the world for its superb performance.

THE GARRARD ENGINEERING AND MANUFACTURING CO. LTD., SWINDON

Out of the CHAOS came the 'CACTUS (followed by the 'PORCUPINE'!)

The first time we looked into a radio set and saw dozens of bits of wire at a loose end we were horrified! Having tidy minds we set about inventing a gadget which would connect up and secure all these wire ends, neatly and permanently.

Here they are, two of them. The 'Cactus,' with four live tags, and the 'Porcupine,' with two earthing points and three live tags—both revolutionary designs which solve anchorage problems.



Constructed of high grade ceramic and silver-plated brass, without any organic materials these UIC Terminal Strips are:

- TOUGH!
- FIREPROOF!
- SPACE-SAVING!
- FREE FROM SOLDER!

UIC

'CACTUS' & 'PORCUPINE' TERMINAL STRIPS FOR RADIO & ELECTRONIC ASSEMBLY

Let's tell you more about the 'Cactus' and the 'Porcupine'—write for catalogue (pages 2028-2029/A)

United Insulator Co., Ltd., Oakcroft Road, Tolworth, Surbiton, Surrey. Tel: Elmbridge 5241/2/3/4

SPECIALISTS IN ELECTRO TECHNICAL CERAMICS & COMPONENTS - SPECIALISTS IN ELECTRO TECHNICAL CERAMICS & COMPONENTS

C.R.T. Display Units

With the basic essentials for visual presentation and designed to provide in simple and convenient form the best means of demonstrating signals from your existing equipment, they will also form display units for the Unitel System of instruments.

Model 1001 incorporates a 5in. diameter cathode ray tube with the following features: ● Post Deflection Acceleration at 4000 v. ● Fine Focus, High Intensity and Sensitivity. ● Self contained operating potentials from 200 to 250 v. A.C. Mains. ● Graticule with variable illumination. ● Full screening against external fields.

Ideal for monitoring production tests.

NAGARD LTD

18, Avenue Road, Belmont, Surrey. VIGilant 0345

Specialists in Oscilloscopes and D.C. Amplifiers

Your problems are our interest — Write for details

L·R·S

EASY TERMS

Estd. 1925

LEAK QUALITY EQUIPMENT *for the Connoisseur*

POINT-ONE TL/12 12-WATT

Triple Loop Feedback Amplifier

For the highest possible quality of reproduction from Pick-up, Radio, Microphone, Film and Magnetic Tape this amplifier has won world-wide recognition. As used by the B.B.C. and many overseas Broadcasting Corporations.

Cash Price £38/7/0.

THE NEW VARI-SLOPE PRE-AMPLIFIER

Gives audibly better reproduction. No chokes to cause magnetic hum pick-up. Extremely low harmonic and intermodulation distortion. Cash Price £12/12/0.

For fuller details see maker's advertisement on p. 85

TERMS for these TWO UNITS

£9 deposit with order and 18 monthly instalments of 40/-.
Passenger carriage 10/- extra, payable with deposit.

LEAK V.S. TUNER AND DYNAMIC P.U. also supplied on similar terms. All the above available separately

---

Armstrong Chassis

Two new models incorporating many new features including Bass and Treble lift controls and improved tuning scales with flywheel action.
MODEL FC38. 3-wavebands 16-50m., 190-500m., 1 000-2,000 m. 8-watt P.P. Output. Cash Price **£23/13/0** (incl. P.T.)
MODEL RF41. 10 valves, 4-wavebands, 12-35, 35-90, 190-550, 800-2,000m. 10-watt P.P. output. Cash Price **£31/19/8** (incl. P.T.).

See maker's advertisement on p. 133

Connoisseur 3-speed **GRAM UNITS** and **LIGHTWEIGHT PICK-UPS** to match, can be supplied from stock.

Wharfedale & Goodmans **LOUDSPEAKERS.** Complete range available.

Illustrated lists of any item and details of our EASY TERMS will be sent upon request by return.

HAVE YOU TRIED?

the amazing ALL-NEW

REMINGTON '60'

ELECTRIC DRY SHAVER

OUR 14 DAYS FREE TRIAL OFFER

WILL CONVINCE YOU

that it really does shave every type of beard quicker and closer than any other method.

SEND ONLY 20/- DEPOSIT for 14 DAYS FREE TRIAL

DEPOSIT RETURNED IN FULL IF NOT SATISFIED. **Balance by 8 monthly payments of 24/-.** Cash Price **£9/19/0.** A.C./D.C. 200/250v. **Brand new,** dispatched by return in silk-lined case, post paid. 12 months maker's guarantee.

THE L.R. SUPPLY COMPANY LTD.

(LONDON RADIO SUPPLY COMPANY)

BALCOMBE Telephone: Balcombe 254 **SUSSEX**

RECEIVERS · TEST EQUIPMENT · AMPLIFIERS · RECORDERS, ETC.

Britain's most comprehensive Suppliers of Electronic Equipment for "Hams" and Industry.

All readers are cordially invited to call and inspect our stocks.

AMPLIFIERS · RECORDERS · SOUND EQUIPMENT

The latest Webster Tape Recorder in case (1953), **£75.** Simon Sound B2 tape recorder as NEW, **£45.** Baird type 2 tape recorder, **£45.** Microphones. Lustraphone, STC, Ronnette, Tannoy, etc. Rogers Amplifiers, **£20.** Disc cutting gear MSS, BSR, U.S.A. 2 speed motors and cutting gear 110 v., **£11.** Loudspeakers in stock. Goodmans, Wharfedale, Vitavox, etc.

BRITISH TEST EQUIPMENT

AVO Model 7 as NEW, **£15.** Model 40, **£12.** AC/DC minor, **£6/15/-.** Roller panel valve testers, **£12.** Electronic test meter by AVO, **£30.** Wide range signal generator, **£22.** AVO valve characteristic meter, **£50.** Taylor: 65B signal generator, **£9.** 65C signal generator, **£13.** 90A test meter, **£10.** 260A TV Wobbulator, as NEW **£30.** Evershed Wee meggers 500 v., **£14.** Bridge type and others in stock. Marconi: Signal generator types TF144G, TF517, TF390/G Valve voltmeters, output meters. Marconi BFO type LO800A, etc. Cossor Double Beam oscilloscopes, type 3339, 339 from **£35.**

TRANSMITTERS

U.S.A. 1953 Harvey Wells, type TBS50. Phone CW. 80, 40, 20, 15, 10, 6 and 2 metres. Crystal Oscillator VFO switching. AS NEW. Less power supply, **£45.** ELMAC transmitter 50 w. Phone or CW. VFO or crystal control, 75, 20, 11, 10 bands. Dual scale meter, less power supply mobile or fixed, **£50.** Latest Job. **£55** NEW. Hallicrafters HT17's, **£25.**

RECEIVERS

All receivers are in good working order and condition unless stated. SX28, 550 kc/s-42 Mc/s., **£48.** SX24, 550-42 Mc/s., **£28.** S20R, 550-42 Mc/s., **£25.** S20, **£20.** S29, AC/DC portable, battery 550-32 Mc/s., **£25.** S38 AC/DC 110-250 v. 550-30 Mc/s., **£25.** Also in stock S27, 30 Mc/s-150 Mc/s., S27CA, 150-230 Mc/s., HT11 A Marine 12 v. radiotelephones. HRO receivers junior and senior types with all coils and power supplies from **£27,** complete. National NC44, NR100, NC81X, NC200. Marconi CR100. 60 kc/s-30 Mc/s., **£28.** RME 69, **£35.** Eddystone receivers: Types 640, **£22/10/-**; 740, **£35**; 750, **£50**; 680, **£65**; 670, **£35**; 504, **£25.** RCA receivers, AR88D and LF from **£55.** Set of three dials for model D, **£1/10/-.** **MANUALS** for the following receivers: AR88D-LF, AR77E, Marconi CR100, S20, S20R, B2 Transmitter/Receiver, H.R.O.s. Photostatic copies of originals **£1/7/6.**

Also in stock. Receivers by many other makers. MCR1 receivers, **£8.** B2 Transmitter/Receiver, **£20.**

U.S.A. MICROWAVE TEST GEAR

No technical manuals for sale. Please write for prices.

TS3. S band power frequency meter. **TS10.** APNI Test set. **TS13.** AP. X band signal generator. **TS14.** S band signal generator. **TS34.** Radar Syncroscope. **TS36.** X band power meter. **TS62.** X band echo box. **TS69.** 300-100 Mc/s. frequency meter. **TS127.** 300-700 Mc/s. frequency meter. **TS226.** 300-1,000 Mc/s. power meter. **BC221.** Frequency meter (Bendix). **BC1277.** S band signal generator. **TS45/AP.** 3 cm. signal generator. **I-222A.** 8-15 Mc/s. 150-230 Mc/s. signal generator. **IE-19** signal generator. **TS89.** Pulse voltage divider. **TS47.** 40-500 Mc/s. signal generator. **TS174.** 20-250 Mc/s. **FERRIS.** 22A signal generator, Dumont scope, type 224A. **GENERAL RADIO** 804B. 30-300 Mc/s. signal generator.

RECEIVERS · KLYSTRONS · MAGNETRONS

American Receivers. APR4 and tuning units. 30-1,000 Mc/s., APR5, 1,000-6,000 Mc/s. **Klystrons** 723/AB, 707A, 707B, CV129. **Magnetrons** 725A, 2J32, 2K33, 2K25, TR cells 1B24, and many other items of equipment covering HF, VHF, UHF and centimetric bands.

★ *OUR ONLY ADDRESS IS* **WE ARE ALWAYS PREPARED TO PURCHASE EQUIPMENT SIMILAR TO THE RANGE NOW OFFERED**

UNIVERSAL ELECTRONICS

***27 LISLE STREET, LEICESTER SQ., LONDON, W.C.2**

Shop hours, 9.30 a.m. to 6 p.m. Thursday, 9.30 a.m. to 1 p.m.

Write, Call or Telephone GERrard 8410 (Day) MEAdway 3145 (Night)

Three-Range **PROBE MILLIVOLTMETER**

Model VM6451

SELF-CONTAINED STABILISED POWER PACK

ACCURACY TO ± 5% OF FULL SCALE DEFLECTION

AUTOMATIC OVERLOAD PROTECTION

Designed to provide direct readings for A.C. voltages from 10 millivolts to 2 volts. Three ranges are provided and readings are accurate within 1db from 50 cycles to 150 megacycles. The double triode measuring valve is detachable from the cabinet. This instrument can also be used for modulation carrier detection with the use of headphones. Write for full specification.

BRITISH PHYSICAL LABORATORIES

Radlett HERTS *Tel: RADLETT 5674-5-6*

dmBP15

LEWIS RADIO COMPANY

for

CHASSIS

Send for free leaflet on our latest 3-waveband 5-valve superhet chassis.

AMPLIFIERS

Send for free leaflets on our 5 and 4½ watt domestic models.

CABINETS

We picture here our latest T/V cabinet at

£15.10.0

Suitable for **ALL** Tubes. Send 1/- for our **NEW** illustrated catalogue of Cabinets, Auto-changers, Loudspeakers and **Armstrong** Chassis. ***We make individual cabinets to specification.***

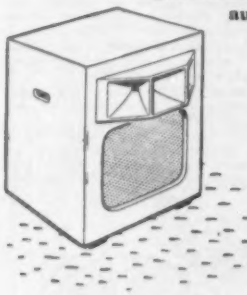
120 Green Lanes, Palmers Green, London, N.13

BOWes Park 6064

Audibility for Auditorium Audiences

BACK ROW... FRONT ROW...STANDING

When the demand is for sound reproduction giving maximum audibility and fidelity to *every* member of the audience, then you can confidently install the Vitavox Bitone Reproducer. We will gladly send you fullest information on request.



Model	3101	6201
Peak watts	10	20
Impedance (nom)	15 ohms	15 ohms
Filter cross-over frequency	1,000 cps	1,000 cps
Filter attenuation per octave	6 db	12 db
H.F. distribution (nom)	60° x 20°	60° x 40°
Finish	Medium oak with metallic bronze horn (and grille on 3101)	

VITAVOX Bitone reproducers

Vitavox Limited, Westmoreland Road, London, N.W.9. *Telephone: COLindale 8671 (PBX).*

WHY BUILD? *when you can buy this*

BAIRD MK. II TAPE RECORDER

for only 59 GNS. *complete*

Fully tested and proved in operation, this famous tape recorder brings high fidelity performance within *your* reach. Look what it offers:—twin track technique, each 1,200 ft. reel giving a whole hour's recording; excellent response between 50 and 10,000 c.p.s.; single control operation of motors; rewind time only 45 seconds! Complete with moving coil microphone and high coercivity tape . . . here's outstanding value for money!

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14 reasons why *those concerned with recorded sound choose*

FERROVOICE

MAGNETIC RECORDING TAPE

1. Does not curl—lies flat on the transducer head, giving better frequency response, and smooth tracking.
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9. The Kraft Paper base has been selected after careful development with the paper manufacturers—flexibility, and super-calendering being prime considerations.
10. The Lacquers are pigmented with the highest grade powder. The individual particle size is less than one micron (0.000039 inch).
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12. The spools were designed to incorporate the "universal" hub, perfect balance, and negligible rotation noise.
13. "FERROVOICE" products are subject to continuous development by our technical staff.
14. "FERROVOICE" has a Coercivity of 270 oersteds (BHC) remanence = 730 gauss, when subjected initially to a magnetising force of H = 2,000 oersteds.

Suitable for Single or Double Track Recording. Length 1,200ft. on 7in. Diameter Spool—Frequency response 50 C.P.S. to 10 kc/s. at 7.5 in. per sec. Breaking Strain exceeds 4lb.

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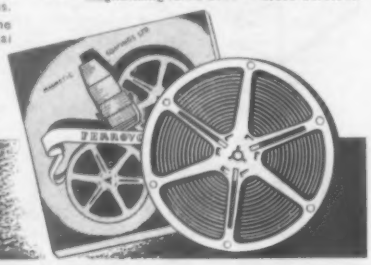

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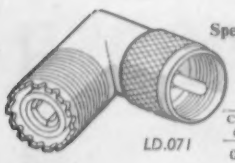
Single and multi-way types.
Special types fitted with coupling rings.
Cable joining connectors.
U.S. Type Connectors as illustrated.



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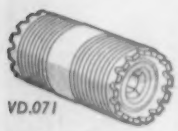
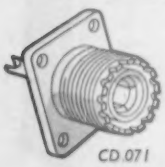


VD.071



CD.071

RD.07/05

CABLE O.D.	TYPE	CODE NO.
0.41"	Straight plug	GD.071
0.25"	Reducing adaptor	RD.07/05
0.2"	Reducing adaptor	RD.07/03
fits on GD.071 CD.071 VD.071	Elbow plug adaptor	LD.071
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fits on GD.071 LD.071	Chassis receptacle	CD.071

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F24. 24 v tapped 12 v. @ 3 amps 23/6
F29. 0-2-4-5-6.3 v. @ 4 amps., 18/9. **FU12.** 0-4-6.3 v @ 3 amps. 17/6
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F6/4. Four windings at 6.3 v. tapped 5 v. @ 5 amps. each, giving by suitable series and parallel connections up to 6.3 v. @ 20 amps. 51/6

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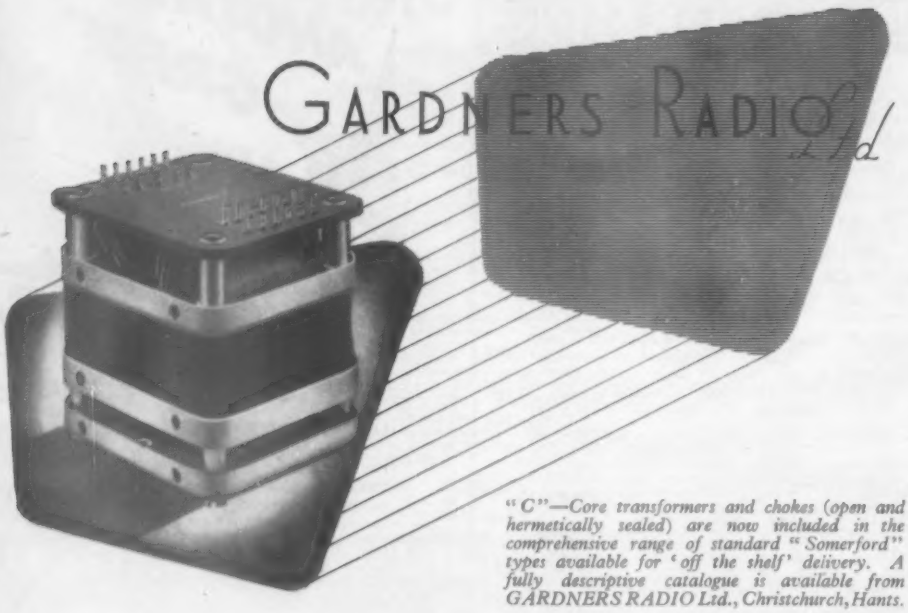

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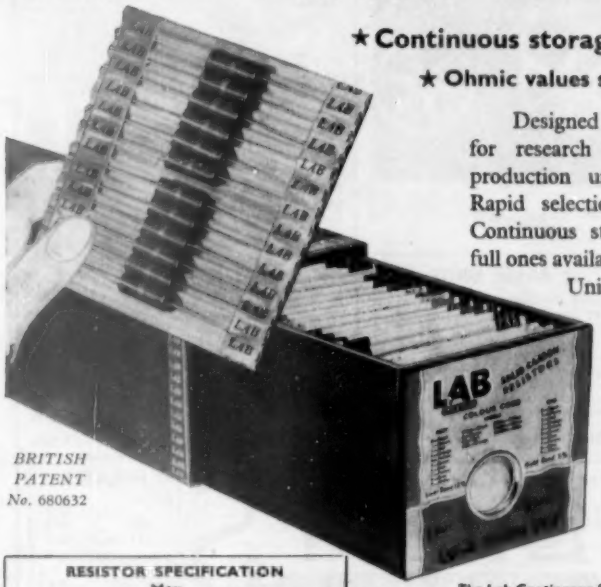

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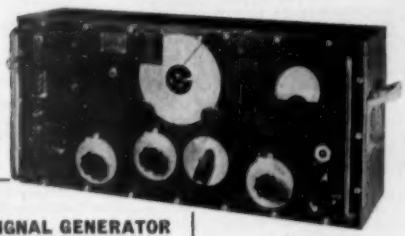

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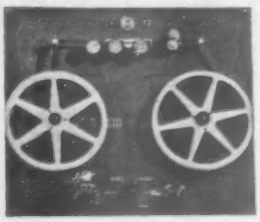

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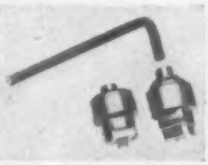

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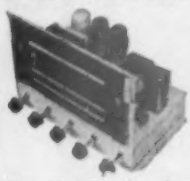

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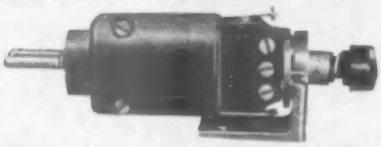

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TAPE AMPLIFIER
New Mk. II AC/54

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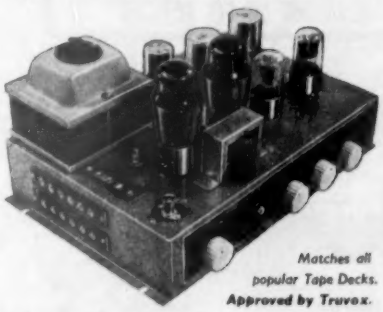

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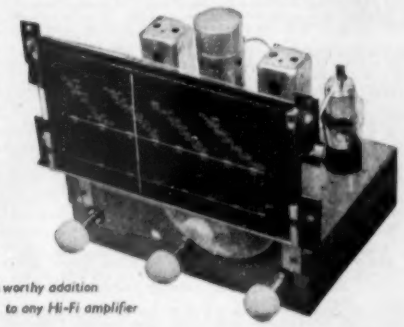

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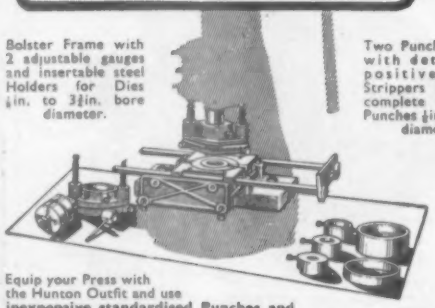

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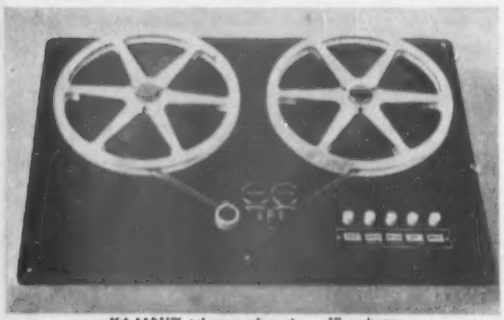

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ELECTROLYTICS. 450 v. wkg. (Gtd. New Stock), 4 mfd., 1/6; 8 mfd., 2/-; 16 mfd., 3/-; 8-8 mfd., 3/6; 8-16 mfd., 4/-; 16-16 mfd. 4/6. **PM LOUDSPEAKERS** (3 ohms), 3in., 13/6; 5in., 14/6; 6in., 15/6; 8in., 18/6; 10in., 22/6. **GERMANIUM CRYSTAL DIODES**, 2/-. **G.I.C.**, 0.1 mfd. 3 kv. TV Condensers, 10/6. **ROTARY SWITCHES**, 3-bank, total of 5 p. 6 w., 3/9. **H.R. HEADPHONES**, 18/6. **SOLON** Miniature **SOLDERING IRONS**, 19/6. 6in. **ENLARGERS** (for VCR97), 17/6. **WEARITE "P" COILS**, 3/-. **ALL CHASSIS**, 2½in. deep, 6in. × 4in., 4/6; 8in. × 6in., 6/-; 10in. × 7in., 7/-; 12in. × 8in., 9/-; 14in. × 8½in., 13/-; 16in. × 9in., 14/-. **TRANSFORMERS** (Mains input Standard Primaries), 250-0-250 v. 80 mA., 0-4-6.3 v. 4 a., 0-4-5 v. 2 a., 19/6; Ditto, but 350-0-350 v., 19/6; 250-0-250 v. 100 mA. 6.3 v. 2.5 a., 5 v. 2 a., 26/6; Ditto, but 350-0-350 v., 26/6.

ORDERS UNDER £1 please add 1/- p. and p. ORDERS £1 and over add 1/9.

FOR INSTANT SERVICE—WRITE:

CITY & RURAL RADIO,

101 HIGH STREET, SWANSEA, GLAM.

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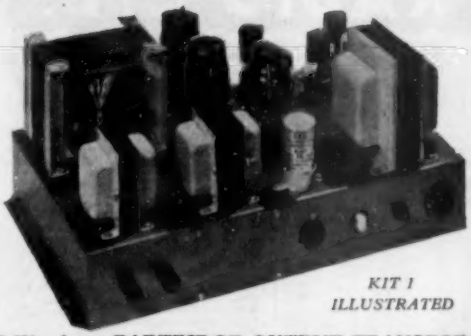
WILLIAMSON AMPLIFIER KITS

KIT 1
WITH ELLISON MAINS TRANSFORMER AND CHOKES
19 GNS.
READY BUILT and tested
23½ Gns.



KIT 1 ILLUSTRATED

KIT 2
WITH PARTRIDGE TRANSFORMER AND CHOKES
21 GNS.
READY BUILT and tested
25½ Gns.

BOTH Kits have PARTRIDGE OUTPUT TRANSFORMERS

Fully drilled and enamelled chassis, T.C.C. and G.E.C. Condensers, Marconi-Osram-Cossor valves, sundries by Colvern, Belling-Lee, Erie, Bulgin, Welwyn, etc., complete to the last nut and bolt, with wiring instructions and layout drawings. *Packing and Carriage £1 extra, 10/- refunded on return of case carriage paid. C.W.O.*

PA1 PRE-AMPLIFIER

In response to numerous requests for a simple, inexpensive pre-amplifier for use with Tele-Radio Williamson Kits we have introduced our PA1. Specification includes full control of Bass and Treble, radio input and switched compensation for standard and long playing records. Recommended for use with ACOS GP20 and GP30, Decca C. & D. heads and Connoisseur Pick-ups. With wiring instructions and lay-out drawings.

KIT OF PARTS 6½ gns. READY BUILT 8½ gns. *Postage and Packing 2/- extra. C.W.O. or C.O.D.*

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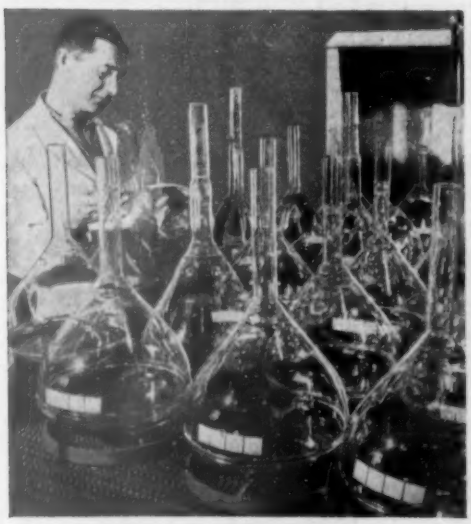
189 EDGWARE ROAD, LONDON, W.2. Phone: PAD 4455/6
SHOP HOURS: MON.-SAT. 9 a.m. to 6 p.m. THURSDAY 9 a.m. to 1 p.m.



This picture, from a recent issue of MECHANICAL HANDLING, *shows cathode ray tubes being removed from a conveyor belt after passing through a Lehr annealing furnace. The belt system largely eliminates manual handling and reduces breakage risks.*

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All goods specially selected for quality and value. Prompt service—Money-back guarantee—It will pay you to visit our new rebuilt shop premises. Situated 50 yds. only from Tottenham Court Road Tube! (Genuine)

THE "ECONOMY FOUR" T.R.F. KIT. A three valve plus metal rectifier receiver. A.C. mains 200/250 v. Medium and Long waves. We can supply all required components right down to the last nut and bolt. Valve line-up, 6K7, 6J7 and 6V6. Chassis ready drilled—Cabinet size 12in. long, by 6in. high by 8in. deep—Choice of ivory or brown bakelite, or wooden, walnut finish cabinet. Complete instruction booklet with practical and theoretical diagrams. Each component brand new and tested prior to packing. Our price £5/15/- complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver—Booklet available at 1/6 post free—This is allowed if kit is purchased later—Please, 2/6 packing and carriage for complete kit.

EX-W.D. CATHODE RAY TUBES. Guaranteed full picture. VCR97 at 40/-, VCR517C at 35/-. Also VCR139A—Ideal for oscilloscope 2½in. screen at 35/-. We also have VCR97 with slight cut-off, very suitable for oscilloscope, testing purposes, etc., at 16/6 only. All these tubes are brand new, in original packing, and tested before despatch. Please add 2/6 packing and carriage for any of the above tubes.

INTRODUCING L.T. RECTIFIERS TYPE B.K. A newly manufactured range, fully guaranteed for 12 months. 6 v. 1 A. Centre Tapped 5/- each.
6 or 12 v. 1 A. F.W. bridge type 7/6
6 or 12 v. 2 A. F.W. bridge type 11/3
6 or 12 v. 3 A. F.W. bridge type 12/6
6 or 12 v. 4 A. F.W. bridge type 15/-
6 or 12 v. 6 A. F.W. bridge type 25/6
6 or 12 v. 10 A. F.W. bridge type .. 37/6

COLLARO RECORD CHANGERS TYPE RC9/521. Complete with two GP27 Crystal Plug-in heads—One for standard and one for Long-playing records. Brand new in sealed cartons at very low price of £9/19/6—Or the same changer with orthodynamic turn-over head, at the same price. Carriage free. Tax Paid.

VERY SPECIAL HIGH-QUALITY RADIOGRAM CHASSIS. We have purchased a limited quantity of these chassis by Britain's leading manufacturers of quality radiograms. Circuit is a 3-wave-band five-valve superhet with A.V.C. Valves 6K8G frequency-changer 6B8G I.F. amplifier, detector and A.V.C. 6BL7GT Combined pick-up amplifier and A.F. Amplifier on Radio and Gram. 6V6G, beam-power output tetrode; 5Z4G full-wave rectifier—Employing a special circuit for gramophone pre-amplification — A continuously variable tone-control provides ample treble correction without accentuating the bass. Large glass dial, horizontal tuning measuring 11in. × 3½in. Chassis measurement: 14½in. × 9in. × 8in. This is a superior chassis designed to sell originally in a Radiogram costing £75. Our price is £12/19/6 only, tax paid, plus 5/- packing and carriage. We will gladly demonstrate this chassis or any other working item from our stocks to personal callers!

CONSOLE RADIOGRAM CABINETS. This is an attractive figured walnut cabinet, originally intended for the above super-het chassis.
It is constructed to take the chassis in the top part, dial being permanently visible through sloping front. Underneath, the gramophone unit is housed in a drawer which slides forward on steel runners—when required for use—Total Cabinet measurement is 36in. high, by 20in. wide by 16in. deep.—Our price for the cabinet only is £9/17/6—plus 10/- packing and carriage.

● The Collaro changer listed above fits neatly in drawer of this cabinet! ●

We can supply the three units, cabinet, chassis and changer, if purchased together at one time, at a price of £32/10/- plus 20/- packing and carriage. May we suggest an 8in. Elac P.M. Speaker at 17/6?

Fully assembled model being demonstrated at our shop premises!

METERS

	F.S.D.	Size	Type	Fitting	Price
200 microamp	D.C.	2½in.	M.C.	F.R.	42/-
250 microamp	D.C.	2½in.	M.C.	F.R.	40/-
500 microamp	D.C.	2in.	M.C.	F.R. or F.Sq.	18/6
500 microamp	D.C.	2½in.	M.C.	F.R.	35/-
1 mA.	D.C.	2in.	M.C.	F.Sq.	17/6
1 mA.	D.C.	2in.	M.C.	F.Sq. (Scale Calib. 1.5kV.)	15/-
1 mA.	D.C.	2½in.	M.C.	Desk Type	27/6
5 mA.	D.C.	2in.	M.C.	F.Sq.	7/6
10 mA.	D.C.	2½in.	M.C.	R.F.	10/-
15 mA.	D.C.	2in.	M.C.	F.R.	7/6
20 mA.	D.C.	2in.	M.C.	F.R.	7/6
50 mA.	D.C.	2in.	M.C.	F.Sq.	9/6
200 mA.	D.C.	2½in.	M.C.	R.F.	10/-
500 mA.	D.C.	2in.	M.C.	R.P.	8/6
0.5 amp.	R.F.	2in.	Thermo	F.Sq.	4/6
1 amp.	R.F.	2in.	Thermo	F. Sq.	5/-
2.5 amp.	AC/DC	2in.	M.I.	F.R.	12/6
3 amp.	R.F.	2in.	Thermo	F.Sq.	7/6
5 amp.	D.C.	2in.	M.C.	F.Sq.	13/6
20 amp.	D.C.	2in.		R.P. (with shunt)	10/6
10 v.	D.C.	2in.	M.C.	R.P.	8/6
150 v.	D.C.	2½in.	M.C.	F.R.	15/-

R.P. = Round projection. Thermo = Thermo-couple.
F.Sq. = Flush Square. M.C. = Moving Coil.
F.R. = Flush Round. M.I. = Moving Iron.

ALL-PURPOSE TEST METERS. We also offer very limited supply of Ex-Naval All-purpose test meters by Everett, Edgecumbe. These instruments are not brand new, but all have been serviced and guaranteed 100 per cent condition. Complete in strong wooden case. Size 9in. × 6in. × 5½in. Leather carrying handle. 3½in. Scale—1,000 ohms per volt—Measures 0-1,000 volts AC/DC—Capacity .02 mfd.-16 mfd.—Resistance to 10 megs.—While stocks last—Price £7/19/6 only! Plus 2/6 packing and carriage.

SPECIAL OFFER.—Garrard AC/DC model "E" centre drive motor—Auto-stop and start for 78 r.p.m.—Speed regulator—Few only at £7/19/6 plus 2/6 packing and carriage We also have in stock—Connoisseur 3 speed motors, pick-ups. Pick-ups and heads, by Garrard, Decca, Collaro, Acos, Chancery, etc., etc., all at current prices!

BRAND NEW R1155A RECEIVERS guaranteed serviceable in original packing cases £11/19/6. Fully assembled Power Pack and output stage to plug straight in to R1155 for A.C. 200/250 volts, at 70/6—Deduct 10/- if purchasing receiver and power pack at the same time.

45 Mc/s PYE STRIP—Brand new complete with 6 valves type EF50 and one EA50 70/- only.

PORTABLE RECORD PLAYER CABINETS. Manufacturer's surplus, brand new. External dimensions 15in. × 16½in. × 8½in. deep. Finished attractively in dark brown rexine. Motor board cut for B.S.R. Monarch Changer, but will take any standard single player; also room for amplifier. Front view shows attractive grill for speaker. Leather carrying handle, two snap locks. Price 45/- only, plus 2/6 packing and carriage. Also available to take any standard single player—brown leatherette covered. Complete with locks and carrying handle. Size 15in. × 13½in. × 5½in., 22/6 only, plus 2/6 packing and carriage.

P.M. SPEAKERS. Elac 2½in., 15/-; Elac, 3½in., 15/-; Plessey, 3in., 9/11; Plessey, 5in., 14/-; 6½in. Goodmans at 14/6; 8in. Plessey at 15/6; 8in. Elac at 17/6; 10in. Plessey at 18/6; 10in. Elac at 22/6; 10in. Lectrona at 17/6; 10in. Rola with Transformer 28/6; 12in Truvox 47/6. All 3 ohm speech coil. Also, the new Baker 12in., 15 ohm 15 watt. A quality speaker at 115/-. Also 2½in. Elac 15 ohm at 15/-. In addition to the above, we can definitely supply from stock, the complete range of new W.B. "Hi-Fi" Speakers, Wharfedale and Goodmans. Also, Wharfedale Cross-over units, Transformers, etc.
Limited quantity only of 6½in. reconditioned P.M. Speakers, by Elac, Goodmans, etc., at 10/6 each. Also, mains energised Plessey 8in. 1,500 ohm. field at 27/6 each.

4-WATT 2-STAGE AMPLIFIER. Valveline-up 6L6, EF37 and GZ32, complete with 10in. Mains Energised Speaker, £6/19/6, plus 5/- packing and carriage.

STUPENDOUS HALF-PRICE OFFER. DECCA RECORD PLAYERS. MODEL 23A. A complete playing-desk, brand new, ready to plug-in. Can be supplied with either standard or long-playing Crystal heads, at £4/19/6 or complete with both heads at £5/19/6. Also available from stock at current list prices, Collaro A.C. 3/534 RC3/531, RC3/532 etc. Garrard RC75A, Garrard RC75, A.C./D.C., RC90A, and perhaps by time of appearance of this advt. RC110. Also, ex-stock, Connoisseur 3-speed motors, Pick-ups by Collaro, Decca, Connoisseur, Rothermel, Acos, Chancery, etc., etc.

TAPE RECORDER CABINETS. We can offer a well-constructed cabinet, handsomely finished in grey or brown rexine, made specifically to take Truvox or Wearite Tape Decks. Measures 23in. × 14in. × 9½in. deep. Completely portable, shows attractive speaker grille at end, and made to take up to 8in. Speaker. We guarantee satisfaction and will be pleased to refund cash if dissatisfied. Ample room for suitable amplifier. Price 79/6, plus 2/6 packing and carriage. N.B., We can supply from stock, the latest Truvox and Wearite Tape Decks at 25 guineas and £35 respectively. Reduction of 20/- on cabinet if purchased at the same time as either of these tape decks!

K.B. WIRE RECORDER AMPLIFIERS. Limited supply of wire-recorder amplifiers complete, by Kolster-Brandes. Chassis measurements: 10½in. × 4½in. × 2in., plus power pack chassis, measuring 9in. × 4½in. × 3in. Valve line-up, 6X5, 6V6, 2-6J5, 2-6J7, and 6U8 magic-eye. Incorporates built-in erase oscillator. These amplifiers are brand new, absolutely complete, but may require very slight attention. However, each amplifier carries a small tag listing any faults, and a complete circuit diagram is provided. Limited quantity only at £5/19/6, plus 5/- packing and carriage.

MAINS TRANSFORMER-MANUFACTURERS' SURPLUS. Black tropical finish. Size 3½in. × 3½in. × 2½in. 250-0-250, 60 m/a. 6.3 v. 2 A. (Centre Tapped) 5 v. 2 A., 10/6 each, plus 1/6 packing and postage.

COLLARO AC 3/514. 3-speed, single player unit. Complete with orthodynamic plug-in pick-up head. For standard or L.P. records. Brand new, complete with matching transformer. Our price £6/19/6, plus 5/- packing and carriage.

LIGHTWEIGHT CRYSTAL HEADPHONES. Brand new, by Rothermel. List price 70/-. Our price 25/-!! Limited supply.

THE "R.C." TAPE RECORDER GENERAL ADVANTAGES.—Very long recording time—complete portability—commensurate with high-quality reproduction. Easy to handle—Incorporating instantaneous mechanical break system. An extra socket is provided for extension speaker. This socket can also be used for monitoring purposes, either through an extension speaker or earphones. A magic-eye level indicator is also provided. For use on 200-250 v. A.C. mains.
CABINET.—High quality, luxurious workmanship. Covered with washable rexine—available in grey, maroon or green. Pigeon-hole is provided for the crystal microphone and mains lead. Built-in, high-grade elliptical speaker. Cabinet size, only 15½in. × 12in. × 5½in. deep. Total weight of the complete machine is 25 lb.
MICROPHONE.—Ultra-sensitive crystal microphone on stand is provided—plugs straight in.
SPEED.—Two speeds—respectively 2.75in. and 5in.
RUNNING TIME.—Slow speed 3 hr. 10 min. Fast speed—1 hr. 50 min. on any standard twin-track recording tape.
PERFORMANCE.—High quality reproduction. Extremely slow hum level. No wow or flutter. Frequency response up to 8,000 cycles on fast speed—up to 5,000 cycles on slow speed.
GUARANTEE.—This machine is fully guaranteed for a period of 12 months from date of purchase.
PRICE.—COMPLETE 45 Gns.

H.T. RECTIFIERS BY S.T.C. Type RM1 at 4/6, RM2 at 5/-, RM3 at 6/-, RM4 at 18/-, DRM1B at 9/6, DRM2B at 10/6. H.T. Rectifiers Type K3/25 at 5/3, K3/40 at 7/6, K3/45 at 8/3, K3/50 at 8/8, K3/100 at 14/6, K3/160 at 21/6, and K3/200 at 26/-.

METER RECTIFIERS. 1 mA. by G.E.C., at 11/6, also 5 mA. by Westinghouse at 8/6.

L.F. TRANSFORMERS. SPECIAL OFFER. All iron-cored 465 K/CS. By Weymouth. Size 2½in. × 1¾in. × 1¼in., 6/6, or Philips, size 2½in. × 1¼in. diameter (cylindrical), 7/6 pair. By Invicta—Cylindrical, 2½in. × 1¼in. diameter, 8/6 pr. Also, our own special ultra-midget, size 1¾in. × 13/16in. × 13/16in. Only 9/9 per pair.

G.E.C. RECORDING TAPE. 1,200ft. on metal spool, at bargain price of 17/6 per spool.

WHIP AERIALS. All copper, 3 sections each of 4ft. Screw in, 7/6 complete.

Painton, miniature 12-way Plug and Socket. Complete 3/11.

DUBOIS RESIN CORED SOLDER. 1 lb. tin, 16 S.W.G., 5/6 per lb.

8 MFD. 1,200 v. PAPER BLOCK CONDENSERS. Size: 5in. × 4¼in. × 3¼in., 15/- each. Many others in stock.

CO-AXIAL CABLE. Standard 80 ohm. brown, stranded centre conductor, 6d. per yard only! Not Govt. surplus. Minimum 12 yds.
We stock Microphones by Lustraphone, Ronette, etc., and have available, ex-stock, the New ACOS Crystal Microphone Type MIC 35-1 at 35/-.

GRELCO EBONITE TERMINAL BLOCKS. 3-way 1/-, 4-way 1/4, 6-way 2/-, 12-way at 3/6.

VALVES. We have a very comprehensive stock of special purpose surplus valves at competitive prices. A stamp will bring Valve Price List.

THE NEW R.C. HIGH-FIDELITY AMPLIFIER. P.P. 6V6 output. Freq. 25—18,000 cps. +—1db Hum—60db at 6½ watts. Treble boost and cut—Brass boost—L.F. correction. Provision for Feeder Unit. Max. UNDISTORTED OUTPUT 9½ watts. Price 16 gns. plus 7/6. NOW AVAILABLE. Kit of Parts, complete with fully illustrated instructions, 13 gns., plus 5/- carriage. Illustrated booklet available separately at 2/6. Attractive metal cover, now available. With built-in carrying handle, 19/6.

BRANDENBURG E.H.T. UNITS. 6-9 kV., 6 gns.; 13-16 kV., 9 gns.; 6-9 kV. Coil, 39/-; 10-15 kV. coil, 55/-. Wiring diagram supplied.

CABINETS. We can supply a cabinet for every requirement, Table Model, Extension Speaker, Portable Player, Console, even for Projection T/V! Why not call and see us?

RADIO-GRAM CHASSIS
3 Wave-band Superhet. Med., long and short
5 Latest Type MULLARD Valves.
4 Position Switching Gram., med., long and short.
Provision for Extension Speaker. A.C. Mains 110/250 volts.
Chassis 11in. x 7in. x 2½in. Scale 8in. Square.
Or Chassis 13½in. x 6½in. x 2½in. Dial 10in. x 5½in.
PRICE £10/5/-.
BRAND NEW AND GUARANTEED
CARR. PACKING AND INS. 10/-.
We can also supply and demonstrate any of the "Dulci" well-known Radio-Gram Chassis, advertised elsewhere in this issue—at list prices.

● Please add postage under £1. C.O.D. or Cash with order. C.O.D. charge extra—Open 9 a.m.-6 p.m., Monday to Friday. Sorry but we close at 1 p.m. on Saturday. ●

CONSTRUCTORS say "IT'S STILL THE BEST MAINS or BATTERY PORTABLE SET"

You're SURE to get it at

STERN'S

ESTABLISHED 25 YEARS

A Midget 4-valve Superhet Portable covering medium and long wavebands. Designed to operate on A.C. mains 200/240 volts or by an "Alldry" battery. The set is designed so that the mains section can be supplied as a separate unit, and can be added at any time. The Set supplied as an "Alldry" battery Superhet can be accommodated in the attache case illustrated (size 9½in. × 4½in. × 7in.), this is attractively finished in lizard, maroon, dark green or blue rexine. As a combined Mains/Battery Superhet Portable a polished cabinet is available to accommodate both Mains Unit and Batteries. Circuit incorporates delayed A.V.C. and pre-selective Audio Feedback. The Set is complete in every detail and includes ready-wound frame aerials, fully aligned I.F. transf. and drilled chassis, etc. Overall size of assembled chassis 8in. × 6in. × 2¾in. This receiver, as illustrated, can be completely built for approx. £10 (plus Mains Unit if required). Send 1/9 for the fully descriptive Assembly Book which includes Practical Layouts and complete Pricelist of Components. Attache case available separately 37/6.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build Midget "Alldry" Battery Eliminator, giving approx. 69 volts and 1.4 volts. This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 69 volts. The Kit is quite easily and quickly assembled and is housed in a light aluminium case, size 4½in. × 1½in. × 3½in. Price of complete Kit with easy-to-follow assembly instructions, 35/6 (plus 1/- carriage and insurance). In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled unit 7in. × 2½in. × 1½in. Price 42/6 (plus 1/- carriage and insurance).

The "Wireless World" 3-Valve Set

A Midget 3-valve T.R.F. Receiver for operation on A.C. mains, covering long and medium wavebands. We are able to supply all of the components to build this set, as designed and specified in the Feb. 1950 issue, including the drilled chassis. Valves and moving coil speaker, etc., at the following prices:—
To construct complete chassis less dial and drive assembly, £5/5/-. Ditto including dial and drive assembly £6. To construct the complete set, including dial and drive assembly and cabinet, £7/3/6. Overall size of cabinet is 7¼in. × 3¼in. × 11¼in. A reprint of the designer's article, giving circuit and assembly instructions (this is available separately for 9d.) together with a practical component layout is included with each of above assemblies.

SELENIUM RECTIFIERS

6 or 12 Volt 1 amp. rating	7/6
6 or 12 Volt 2½ " "	12/6
6 or 12 Volt 4 " "	17/6
6 or 12 Volt 6 " "	£1/7/9

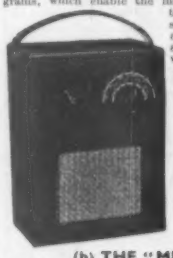
THE WILLIAMSON AMPLIFIER

We have the complete range of specified Components in stock for this famous quality Amplifier. Enquiries are welcomed and immediately dealt with. The complete assembly instructions and diagrams are available for 3/6.

TWO BATTERY PORTABLES

(a) THE "MINI TWO-THREE"

An "Alldry" Battery Portable of midget size, 6¼in. × 4¼in. × 3¼in., designed to cover medium waveband 190-559 metres, with use of short trailer aerial.
The simple design of this Receiver is so arranged that either a 3-valve set or a 2-valve (afterwards easily converted to the 3-valve) can be made.
Consists of a T.R.F. circuit using a regenerative detector with H.F. stage and a high gain output pentode. Valve line up 1T4—1T4—DL94.
The 2-valve set can be completely built for £4/3/6 (less case), and the 3-valve for £5/3/- (less case). Each price includes valves, speaker and drilled chassis.
Send 2/- for the assembly instructions: they include simple and complete practical component layouts and diagrams, which enable the most inexperienced constructor to successfully build either set. All components are available for separate sale, a price list being supplied with assembly instructions.



(b) THE "MINI-FOUR"

A 4-valve Battery Superhet Receiver designed to receive 4 pre-set stations, three on medium waveband and one on long wave to suit local conditions. Each station is obtained on the set by the turn of a rotary switch. No tuning is necessary.
It is of midget size, being only 4¼in. × 6¼in. × 4¼in. when completely built and is very easily assembled from diagram supplied.
Cost of all components to build this set in accordance with the design, including a drilled and cut chassis and panel and new valves, is £6/10/- (or less valves for £6/7/6). Attractive carrying case finished in blue leatherette, 16/9. Complete constructional data with a blue print, which shows the practical component layout and wiring diagram, together with an individual component price list are available separately, 1/6. Our battery eliminators (illustrated above) available in kit form are suitable for use with this set.

WE HAVE THE NEW W. B. "STENTORIAN" HIGH FIDELITY SPEAKERS IN STOCK

Model H.F. 6-inch	£2 10 6
Model H.F. 9-inch	£3 7 0
Model H.F. 8-inch	£3 0 6
Model H.F. 10-inch	£3 13 6

These speakers are of the very latest design and provide quality reproduction for the lower-price range. 3 or 15 ohm models are available.

THE VIEWMASTER TELEVISOR

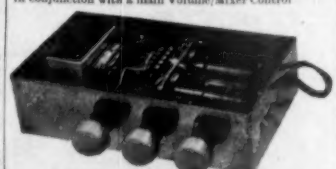
We have had very considerable experience in assisting customers to build this T/V and can supply SPECIFIED COMPONENTS EX-STOCK. The assembly instructions showing practical layouts and price list are available for 7/6 for London, Sutton Coldfield, Holme Moss, Kirk-o-Shotts and Wenvoe.

"MINI-TWIN" 1-VALVE BATTERY SET

A design of a simple 1-valve 2-stage Battery Receiver, giving excellent results on medium and long wave-bands and having exceptionally low battery consumption. Drilled chassis and practical diagrams make it the ideal set for the beginner to build.
The complete chassis, including valve, can be built for 37/6 plus 8/11 P/Tax, the attractive plastic case is 9/6, and suitable headphones, 14/9.
The complete assembly instructions, layouts and a component price list are available for 1/6.
This Receiver also performs excellently, without modification, as a tuning unit, and, in addition, with simple modifications for which a complete diagram is provided, makes a first-class pre-amplifier for pick-up or microphone.

A DUAL CHANNEL PRE-AMPLIFIER and TONE CONTOL UNIT

This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides a full control of bass and treble in conjunction with a main Volume/Mixer Control



It can be used with any amplifier and with any pick-up, the range of frequency control provided by the unit affording ample compensation for all types of pick-up and all natures of recordings, i.e., English, American and long-playing, without recourse to pick-up correction.
The extreme flexibility of the bass and treble controls is such that the level of brass and treble can be set to suit any conditions (irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier advt.
The unit measures only 7in. × 4in. × 2in., including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price, including drilled chassis, valves (6SN7 and 6J5), £3/16/9. Complete assembly data is available separately for 1/-. Completely assembled and ready for use, £5/5/-.

A Famous Manufacturer's SHADED POLE GRAM MOTORS 10/6

(Plus 1/- carr. and ins.)
Clockwise rotations and incorporates a Mains Adjustment Panel. Could also be used as Recording Take Up or Rewind Motor.

A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR

11¼" × 4¼" × 3½"

A design of a complete 5-VALVE SUPERHET RECEIVER employing an R.F. stage and incorporating a separate VIBRATOR PACK size 4½ × 3½ × 6½in. for use on 6 or 12 volt D.C. supplies. We can supply all components to build this complete Receiver and Vibrator Pack including a Metal Case.
Valves, Drilled Chassis and 5in. P.M. Speaker for £12/19/6. (Carr. and Ins. 5/6 extra).
Or the receiver Components for £9/19/6, and the Vibrator Components for £3.
This is NOT an EX-GOVT. Receiver, it is a new design employing new Components.
Send 2/6 for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and PRACTICAL LAYOUTS, including a complete individual Component Price List.

THE DENCO ULTRA MIDGET SUPERHET COIL TURRETS WITH A ROTARY TURRET ACTION

Type CT9 consists of a four-station "pre-set" unit from which any three stations on medium waveband and one on long wave can be received by a turn of the turret switch. Price 39/6.
Type CT10, is a 3 waveband coil pack incorporating a fourth switch position for Gram. Complete coverage is, long waveband 700-2,000 metres, medium waveband 190-570 and shortwave 15-50 metres. Price £2/8/-.
A complete receiver circuit and all necessary data are included with each turret. These can be supplied separately for 6d.

SPECIAL OFFER

A 12in. P.M. SPEAKER (2-3 ohm Voice Coil) by a very famous manufacturer for only 49/6 (plus 2/- carriage and insurance). THESE ARE BRAND NEW IN MAKER'S CARTONS

"HOME CONSTRUCTORS" THE NEW "SOUNDMASTER"

TAPE RECORDER IS NOW AVAILABLE

Send 6/6 for the complete set of building and operating instructions. These provide for an easily assembled complete PORTABLE TAPE RECORDER including a component price list enabling all components to be bought separately.

When submitting please include cost and packing charge

STERN RADIO LTD.

109 & 115 FLEET STREET, E.C.4
Tel: CENTRAL 5812-3-4

You're sure to get it at Stern's

Constructors everywhere are amazed!

AT THE EXCELLENCE OF

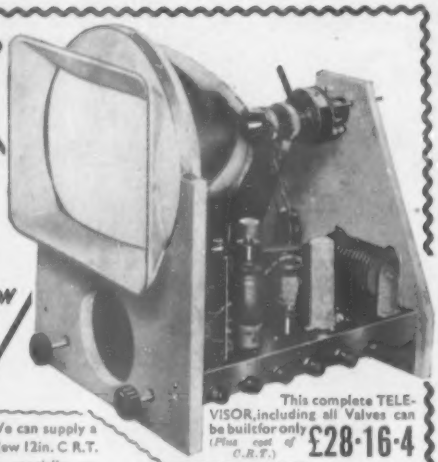
The **"TELE-VIEWER"**

5 CHANNEL TELEVISOR

DESIGN OF A COMPLETE 12" SUPERHET T.V. RECEIVER

HUNDREDS SOLD IN 4 MONTHS — SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY

PERFECT FRINGE AREA RECEPTION — BETTER RECEPTION AT HALF COMMERCIAL COST



This complete TELE-VISOR, including all Valves can be built for only (Plus cost of C.R.T.) £28·16·4

We can supply a New 12in. C.R.T. at specially reduced price of £12-19-6

Here are some of the features which combine to make this such a fine receiver.

- The Superhet circuit easily tuned to any of the five channels, i.e., LONDON, SUTTON COLDFIELD, HOLME MOSS, WENVOE and KIRK-O-SHOTTS. (The extreme ease of tuning is accomplished by the provision of pre-aligned I.F.T's.).
- A lifelike, almost stereoscopic, picture quality made possible by the following factors:
  a. Excellent band width of I.F. circuits.
  b. A really efficient video amplifier.
  c. C.R.T. Grid modulated from low impedance source.
  d. High E.H.T. voltage (approx. 10 kV.).
  The picture brilliance is also much above the average and enables comfortable viewing with normal room lighting or daylight.
- FIRM picture "HOLD" circuits (Frame-Line) ensures a steady picture, free from bounce or flicker even under the most adverse conditions met with in "fringe" areas and excellent "interlace" ensures the absence of "liney effect."
- Negative feedback is used in the audio frequency circuits which provide 2/3 watts of High Quality Sound.
- Entire receiver built on two chassis units each measuring 14½" x 6½" x 3½".
- Rigid C.R.T. mounting enables entire receiver to be safely handled with tube in position.
- All pre-set controls are mounted on side of chassis enabling all adjustments to be carried out whilst facing the C.R. Tube.

As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage) thus enabling hire purchase interest rates to be avoided. The complete set of ASSEMBLY INSTRUCTIONS is now available, price 5/-. The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE. A CABINET WILL ALSO BE AVAILABLE.

Stern's NOW introduce

The "WIDE ANGLE" TELE-VIEWER

The Design has been completed and will be available to Constructors on the 20th JANUARY.

- It can be completely built including supply of all valves for **£34** plus cost of C.R.T. and is as simple to construct as the 12in. model.

- Retaining all the distinctive features of the 12in. Televisor with increased Time Base efficiency producing 15 to 16 K.V. E.H.T., with ample scanning power for C.R. Tubes up to 14in.
- This is the most efficient "WIDE ANGLE" large screen design yet offered to constructors, and yet it can be built for almost half the cost of similar designs.
- The Instructional Manual will also be available on January 20th, price 5/-.

Ex W.D. TESTMETER

Complete with case and carrying strap.

23/6 Post and Ins. 1/3

Provides direct readings of
(a) 1.5 volts and 3 volts D.C.
(b) 6 mA. and 60 mA. D.C. current.
(c) 500 ohm and 5,000 ohm resistance ranges.

Voltages can be increased to 150, 300 and 600 volts D.C. at 6 mA. P.S.D. by an external series resistor arrangement for 6/-.

AN AMAZING OFFER!

A COMPLETELY ASSEMBLED 4 VALVE T.R.F. CHASSIS

Including a 5in. P.M. SPEAKER and VALVES

FOR ONLY **£6.9.6** (Plus 7/6 carr. and ins.)

This receiver is of the very latest design and is for use on A.C. or D.C. Mains. It covers both Long and Medium Wavebands, and includes the modern BVA miniature valves. The line up being 12 BA6- 12AT6- 12A6- 35W4. It incorporates Permeability Tuned Coils thus ensuring excellent selectivity and sensitivity. The overall size of the complete chassis including speaker is 10½in. x 4½in. x 6½in. An attractive Bakelite Ivory finished Cabinet size 11½in. x 5½in. x 6½in. is available for 16/6 (plus 2/6 carriage and insurance).

SMITHS "PRESET" SELF-STARTING SYNCHRONOUS CLOCK

incorporating automatic "on-off" winding.

SPECIAL OFFER **57/6** (Normal Price £4-7-6).

(Postage and Packing 1/3)

NEW!! and carries maker's guarantee.

- WILL SWITCH ON (AND OFF) YOUR RECEIVER AT ANY PRESELECTED TIME.
- WILL ALSO OPERATE ANY APPARATUS (i.e. LIGHTING etc.) UP TO 200 WATTS.
- EASILY INSTALLED—SIMPLY CONNECTED IN THE MAINS LEAD.
- THE IDEAL "ALARM CLOCK."
- FOR USE ON A.C. MAINS 200-250 VOLTS.

HIGH FIDELITY PICK UP

Incorporating the famous CONNOISSEUR Light Weight Moving Iron Head and including the Connoisseur matching Transformer (plus 1/- carriage and ins.) **39/6**

!! The TRUVOX TAPE UNIT !!

We can now offer this very successful Unit ex stock. Price **£23/2/0**
(Plus 5/- carr. and ins.)

A really good class TAPE AMPLIFIER is also available. Price **£16/16/0**
(Plus 5/- carr. and ins.)

The combination of these two Units provides a really first-class complete TAPE RECORDER. Send S.A.E. for complete details.

FOR HOME CONSTRUCTORS

A 5 VALVE 3 WAVEBAND SUPERHET RECEIVER FOR £10.10.0

For use on A.C. Mains 200 to 250 volts.

The following are outstanding features:

- A superhet circuit designed for high efficiency on all three wavebands.
- A 3½in. P.M. Speaker accurately matched for good quality reproduction.
- The latest range of new 6-volt B.V.A. miniature valves.
- Built-in frame aerial with provision for external aerial for distant stations.
- A white plastic cabinet of very attractive appearance, overall size 7½in. x 5½in. x 5½in.

Send 2/6 for the fully descriptive stage by stage assembly and wiring diagrams, with which complete price details are given.

The GARRARD Model RC75A

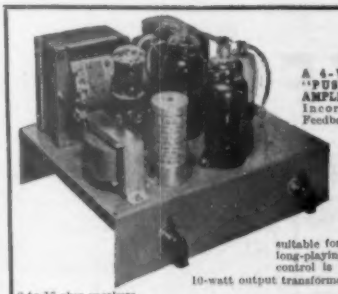
A 3 SPEED AUTOCHANGE UNIT

COMPLETE WITH THE TWIN STYLUS CRYSTAL PICK-UP **£13/15/0** (Plus 7/6 carr. & ins.)

- These Units will autochange on all three speeds, an adaptor, price £1/0/7, being required for the 45 r.p.m. Records.
- They have separate sapphires for L.P. and 78 r.p.m. which are moved into position by a switch on the pick-up head. These Units are one of the best made today, they are brand new, complete with mounting instructions, etc.

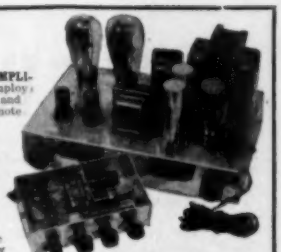
AMPLIFIERS !

TWO COMPLETE KITS OF PARTS



A 4-VALVE QUALITY "PUSH-PULL" 6-8 watt AMPLIFIER for A.C. mains. Incorporating Negative Feedback. Filter Input Circuit and employing 6V6's in Push-Pull. A simple arrangement is provided to enable either a magnetic-crystal or lightweight pick-up to be used, and is suitable for use with Standard or long-playing records. A tone control is incorporated, and the 10-watt output transformer is designed to match 2 to 15 ohm speakers.

The overall size of the assembled chassis is 10in. × 8in. × 7¼in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, **£6/17/6**. Price of assembled chassis, supplied ready for use, **£8/12/6**. Plus 5/- Carr. & Ins. Full descriptive leaflets are available separately for 1/-.



A 12-watt HIGH FIDELITY "PUSH-PULL" AMPLIFIER designed for A.C. mains 200 to 250 volts, employs 6 valves plus rectifier with negative feedback, and comprises a main amplifier chassis and a remote controlled Preamplifier and Tone Control Unit, incorporating four controls—bass, treble, main volume or mixing control, and a radio, gram., microphone, selector switch. This control unit measures only 7 × 4 × 2in. The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 20. It can be seen, therefore that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps. and 30 mA. H.T. is provided for tuning unit, etc. Price of complete kit, including drilled chassis and valves, **£14**. Complete specification and layout, 2/-. We can also supply completely assembled and ready for use at **£17**. Plus 7/6 Carr. and Ins.

THIS AMPLIFIER COMPARES WELL WITH THE WILLIAMSON AND SIMILAR DESIGNS AT A FRACTION OF THEIR COST.

MODERNISE YOUR OLD RADIOGRAM

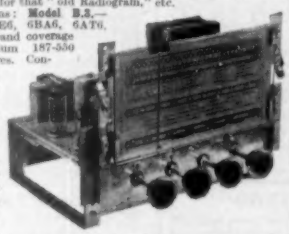
WITH THE VERY LATEST EQUIPMENT FOR **£25**

Half the price of comparable commercial 3 speed Auto Radiogram.

THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

- **Model B.3.** A 5-valve 3-waveband Receiver.
- **Model B.3.P.P** A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.
- **Model B.3.P.P./R.F.** A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The three Receivers are for operation on A.C. mains 190/200 volts and 200/250 volts, and employ the very latest miniature valves. They are designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram. and radio, making them the ideal replacement chassis for that "old Radiogram," etc.



Brief specifications: **Model B.3.**—Valve line-up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4—waveband coverage shorts 16-50 metres, medium 187-550 metres, long 900-2,000 metres. Controls: (1) volume with on/off; (2) tuning (flywheel type); (3) wave-change and gram.; (4) tone (3-position switch operative on gram and radio). Negative feedback is employed over the entire audio stages. Chassis size: 11 × 7½ × 8in. high. Dia. size 9¼in. × 4¼in. Price complete and READY FOR USE, excluding speaker, **£12/12/-** (carr. and Ins. 7/6 extra).

Model B.3. P.P. This model is the B.3 Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. **Price £15/15/-** (plus 7/6 carr. and ins.).

Model B.3. P.P./R.F. This model is similar in appearance and has same waveband coverage as the Model B.3, but in addition it incorporates an R.F. STAGE together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6BW6 in Push-Pull. This makes for a really sensitive receiver with genuine quality reproduction. **Price £19/19/-** (plus 7/6 carr. and ins.).

This AUTOCHANGE UNIT by a Famous Manufacturer is offered for £11/14/6

We will supply this 3 speed Autochanger and the Model B.3 Chassis on the left together with a 10in. (or 8in.) PM Speaker for **£25** or with the B.3. P.P. for **£28/7/6** or with the Model B.3 P.P. / R.F. for **£31/5/-**. Carr. and Ins. 10/-.

(Plus 7/6 Carr. and Ins.). (Normal price is £16/10/-).

- These units will auto-change on all three speeds, 7in., 10in. and 12in.
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 16in. × 12½in. with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

The COLLARO 3RC/521 3 Speed AUTO CHANGE UNIT £9/17/6

We will supply this 3 speed Autochanger and the Model B.3 Chassis on the left together with a 10in. (or 8in.) P.M. speaker for **£23** or with the B.3.P.P. for **£26/5/-**, or with the Model B.3.P.P./R.F for **£29**. Carr. and Ins. 7/6 extra.

(Including Carr. and Ins.). (Normal price is £18/10/-).

- With separate crystal heads for standard and L.P. records.
- Incorporating pick-up weight adjustment.
- Will autochange on 7in., 10in. and 12in. records not intermixed.
- Minimum Base plate size 15in. × 12½in., with height above 4½in. and below baseplate 3in.

● Brand new in Makers Cartons, complete with Mounting instructions

The COLLARO 3RC/514 3 Speed Non-Auto Change Unit

£6/19/6

We will supply this 3 speed Record Player and the Model B.3 Chassis on the left together with a 10in. (or 8in.) P.M. speaker for **£20**, or with the B.3.P.P. for **£23/5/-**, or with the Model B.3.P.P./R.F. for **£26** Carr. and Ins. 7/6 extra.

(Plus 5/- Carr. & Ins.) (Normal price £12/7/6.)

- With the New Autodynamic Hi-Fi Magnetic head and matching transformer.
- Incorporating separate alloy stylii for L.P. and standard records which are moved into position by a simple switch together with pick-up weight adjustment.
- These units are quite new and contained in the makers original cartons complete with Mounting Template.

A COMPLETE KIT OF PARTS TO BUILD A 3-4 WATT HIGH GAIN AMPLIFIER

For operation on A.C. or D.C. Mains, 200-250 volts.

This amplifier will give 3 watts output for the small input voltage of only 75 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H/F Magnetic type.

A tone control is incorporated and the quality produced is excellent. The overall size of chassis is 9in. × 5in. × 7in. and valve line-up 25Y5-6sH7-25L6. Price of complete kit, including drilled chassis and valves, **£4/2/9**, plus 6½in. P.M. (which fits on chassis), **16/-**, or 8in. P.M., **18/9**. Price of fully assembled chassis ready for use, **£5/5/-** (plus cost of speaker). Copy of assembly instructions and components price list available for **1/3**.

The "REGENT" Crystal Hand Microphone 25/6

Plus 1/- Carr. & Ins. Complete with screened lead List Price 42/2/-.

The COLLARO Model A.C. 514 Record Player

£3/19/6

(Plus 5/- carr. and ins.) RIM DRIVE 78 r.p.m. complete with the COLLARO Plug in type MAGNETIC HEAD and 10 inch TURNTABLE. These are COMPLETE BRAND NEW UNITS for A.C. Mains 200-250 Volts.

HALF-WAVE H.T. RECTIFIERS

250 Volts 150 m/a **12/9**; 250 Volts 250 m/a. **16/9**.

The DENCO M.T.O.I. Modulated Test Oscillator £3/15/-

(Plus 2/- carr. and ins.). Has Frequency range continuously variable from 170-475 Kc/s and 550-1,600 Kc/s. Battery operated and thereby completely self contained.

BATTERY CHARGER KITS

All Kits are for A.C. Mains 200-250 Volts. They comprise of a Metal Rectifier and Transformer, tapped for 6 or 12 volt charging, and a tapped Resistor, with Selector Switch, to enable the charging rate to be varied.

For 6 or 12 volt batteries at max. 1 amp. **£1/17/6**
For 6 or 12 volt batteries at max. 2½ amp. **£2/5/3**
For 6 an 12 volt batteries at max. 4 amp. **£3/2/6**
An easily followed Wiring Diagram is included with Each Kit.

VARLEY HEATER TRANSFORMER

Input 200-250 volts. Output 6 volts (centre tapped) 3 amps **14/9** (1/- postage).

When submitting orders, please include post and packing.

STERN RADIO Ltd.

109 & 115, FLEET STREET, E.C.4

Tel.: CENTRAL 5812-3-4

NEW YEAR OFFERS

"PYE" 45 Mc/s I.F. STRIP. Ready made for the London Vision Channel. Complete with 6 valves EF50 and 1 EA50. BRAND NEW ONLY 70/- (postage, etc., 2/6).

I.F. STRIP 194. An easily modified strip recommended for T.V. constructors who want good results at moderate cost, or for those who have built televisors but are having trouble in the sound or vision receivers. Size 18in. x 5in. x 5in., it is complete with 6 valves VR65, 1 of VR92, and 1 of VR56 or VR53. Mod. data supplied ONLY 45/- (postage, etc., 2/6). Less valves, 19/6 (post, etc., 2/6).

RECEIVER R.1355, as specified for "Inexpensive Television," a copy of which is supplied. Complete with 8 valves SP61 and 1 each 5U4G and VU120 or VU111. Used, but good condition, ONLY 29/6 (carriage, etc., 5/6).

RF UNITS TYPE 26 and 27. For use with the R.1355 or any receiver with a 6.3 v. supply. These are the variable tuning units which use 2 valves EF54 and 1 of EC52. Type 26 covers 65-50 Mc/s (5-6 metres), and Type 27 covers 85-65 Mc/s (3.5-5.0 metres). Complete with valves, and BRAND NEW IN MAKER'S CARTONS. ONLY 39/6 each.

RF UNIT TYPE 24. Complete with 3 valves SP61 and full details of modification required to cover all TV Stations, ONLY 25/-.

RECEIVER R.1225. Covers 100-150 Mc/s, and contains 5 valves EF50, 2 of EF39 and 1 of EB34, together with a multitude of short-wave components. An excellent little breakdown unit for ONLY 23/- (postage, etc., 2/6).

TELESCOPIC AERIAL. Pulls out of metal tube 15in. long to extend to 73in. BRAND NEW ONLY 7/6 (post 10d.).

AMPLIFIER 208. Ideal for conversion into a high gain TV pre-amp. Complete with 2 valves EF50. ONLY 15/- (postage, etc., 1/6).

CHOKES. 3H 40 mA., 3/6. 10H 60 mA., 4/- 30H 100/150 mA., 12/6 (postage 1/-).

CHASSIS OF POWER UNIT 529. An ideal unit for component value or for building an amplifier, etc. Contains valveholders, resistors, potentiometer chokes, and block and tubular condensers. Housed in grey metal case-size 12in. x 8½in. x 7½in. BRAND NEW ONLY 10/- (carriage, etc., 3/6).

AMERICAN 12v. DYNAMOTORS. Output 255 v. 60 mA. ONLY 22/6.

24v. BLOWER MOTORS. ONLY 17/6.

C.R. TUBE VCR97. Tested full screen. BRAND NEW IN MAKER'S CRATES. ONLY 42/6.

6 v. VIBRATOR UNITS. Made by the National Co. of America for use with H.R.O. Communications Receivers, supplying 165 v. at 85 mA, fully smoothed D.C. Complete with vibrator and 6X5 rectifier in black crackle cabinet size 7in. x 7½in. x 6in. ONLY 29/6 (postage, etc., 2/6).

COMMUNICATIONS RECEIVER R.1155

The famous ex-Bomber Command Receiver known the world over to be supreme in its class. Covers 5 wave ranges: 18.5-7.5 Mc/s, 7.5-3.0 Mc/s, 1,500-600 kc/s, 500-200 kc/s, 200-75 kc/s, and is easily and simply adapted for normal mains use, full details being supplied. Aerial tested before despatch. BRAND NEW AND UNUSED IN MAKER'S TRANSIT CASES, ONLY £11/19/6.

USED RECEIVERS, also tested working before despatch, £7/19/6.

R.1155 "N" Model. This is the latest version which covers the Trawler Band and in addition has ultra-slow motion tuning. Used, in good condition, and tested working before despatch, £17/19/6.

A Factory-made Power Pack, Output Stage and Speaker, contained in a black crackled cabinet to match the receiver, can be supplied for ONLY £5/10/-. Plugs on to the receiver, and operates it immediately.

DEDUCT 10/- IF PURCHASING RECEIVER AND POWER PACK TOGETHER.

Please add carriage costs of 10/6 for receiver, and 5/- for Power pack.

AVO MODEL 40 UNIVERSAL TEST METERS

Completely self-contained, and provides 40 ranges of A.C./D.C. current, voltage, and resistance. Have had some use but every instrument has been thoroughly checked and tested and is GUARANTEED IN PERFECT WORKING ORDER. ONLY £9/19/6.

INDICATOR UNIT TYPE 62A

Built on a two deck chassis, this contains VCR 97 Cathode Ray Tube with mu-metal screen, 12 valves EF50, 4 of SP61, 3 of EA50, and 2 of EB34. An economical way of buying a VCR 97 and EF50s. IN NEW CONDITION IN MAKER'S TRANSIT CASES. ONLY 99/6 (carriage, etc., 10/6).

ROTARY POWER UNITS TYPE 104

Input 12 v., Output 230 volts 65 ma., and 6.3 volts 2.5 amps. Fully filtered and smoothed and noise suppressed. Ideal for car radio, etc. BRAND NEW. ONLY 15/- (postage, etc., 2/6).

100 MICROAMPS METERS

2½in. circular flush mounting. Widely calibrated scale of 15 divisions marked "yards" which can be rewritten to suit requirements. These movements are almost unobtainable to-day and being BRAND NEW IN MAKER'S CARTONS are a snip at ONLY 42/6.

V.H.F. RECEIVER R.1132.A

An 11-valve receiver, covering 100-124 Mc/s. Has large tuning dial with slow motion drive, R.F. and L.F. gain controls, phone and line output sockets, and 0-5 mA., tuning meter. In grey enamelled metal case with plated handles, size 18in. x 10in. x 11in. Complete with valves, circuit diagram, and calibration chart. IN BRAND NEW CONDITION IN MAKER'S TRANSIT CASES, ONLY 45/- (carriage 7/6).

POWER UNIT TYPE 3

Made for use with the R.1132.A, this is a standard rack mounting job to match the receiver, and is for 200/250 v. 50-cycle mains with outputs of 250 v. D.C. 100 mA., and 6.3 v. 4 amps. Fitted with H.T. current meter and voltmeter, this is a first-class unit, and can be used for a variety of receivers. Used but tested working before despatch. ONLY 90/- (carriage, etc., 5/-). Connecting Cable with Jones Plugs for receiver and power unit, 10/-.

RECEIVER R3118, ideal for conversion to T.V., having a built-in A.C. mains Power Pack for 180-240 volts, is tremendously powerful employing 7 I.F. stages of 12 Mc/s with 4 Mc/s Bandwidth and has 16 valves as follows: 6 of SP61, 4 of EA50, 2 of VR136, 1 each VR137, P61, 5Z4, and Y63 "MAGIC EYE" IN NEW CONDITION only 97/6 (carriage, etc., 7/6).

VACUUM PUMPS. For Handymen and Model Makers. Ex-R.A.F. Type B3-Mk.III, made by Romec. BRAND NEW IN MAKER'S CARTONS, ONLY 15/- (post 2/-).

TRANSFORMERS. Manufactured to our specification and fully guaranteed. Upright mounting, fully shrouded, normal primaries.
425 v.-0-425 v. 250 mA., 6.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a., 50/-.
350 v.-0-350 v. 160 mA., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a., 42/6.
350 v.-0-350 v. 150 mA., 6.3 v. 5 a., 5 v. 3 a., 32/6.
250 v.-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., 32/6.
Please add 2/- per transformer postage.

TRANSFORMERS, FILAMENT. 6.3 v. 2 a., 7/6; 6.3 v. 3 a., 10/6 (postage 1/-).

TRANSFORMERS, EHT Upright mounting.
EHT for VCR97 Tube 2500 v. 5 mA. 2 v.-0-2 v. 1.1 a., 2 v.-0-2 v. 2 a., 37/6.
EHT 5,500 v. 5 mA. 2 v. 1 a., 72/6.
EHT 7,000 v. 5 mA., 2 v. 1 a., 82/6.
EHT 7,000 v. 5 mA., 4 v. 1 a., 82/6.
Please add 2/- per transformer postage.

TRANSFORMERS, EX-W.D. AND ADMIRALITY, built to more than 50 per cent. safety factor with normal A.C. mains primaries. All brand new and unused. 330-0-330 v. 100 mA., 4 v. 3 a., 22/6.

E.H.T., 1,400 v. 2 mA., 520 v. 10 mA., 300 v. 10 mA., 2 v. 1.5 amp., 21/-.

L.T. 6.3 v. 7.7 amp., 4.2 v. 2.5 amp., 4 v. 1 amp., 19/6.

L.T. 4 v. 20 amp. C.T., 30/-.
Please add 2/6 per transformer postage.

INTERNATIONAL OCTAL PLUG. Fits into I.O. valve holder, 2/- (post 3d.).

GANGED POTENTIOMETERS. Double 50K and double 1 meg., 7/6 each.

CERAMIC 2-WAY 3-BANK SWITCHES, 7/6 each.

2½in. SQUARE FLANGE, 0-1 mA. Meters, brand new, only 15/-.

P.M. SPEAKERS. 6½in. ROLA with transformer 17/6, 10in. LECTRONA with transformer 27/6. 12in. GOODMANS, less transformer, 15 ohms speech coil, 99/6. ALL SPEAKERS BRAND NEW IN MAKER'S CARTONS. Postage 2/- each please.

U.E.I. CORPORATION

Cash with order please, and print name and address clearly

Radio Corner, 138 Gray's Inn Road, London, W.C.1. *'Phone:* TERMINUS 7937

(Open until 1 p.m. Saturdays. We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross)

AMOUNTS GIVEN FOR CARRIAGE REFER TO MAINLAND ONLY.

GARRARD RECORD PLAYERS

For 6 and 12 v. operation, complete with magnetic pick-up and volume control. In metal cabinet size: 17in. × 14in. × 11in. Very limited quantity.

LASKY'S PRICE Carriage 10/- extra. **£5.19.6**

HEARING AIDS

By well-known Manufacturer. In metal case, size: 2½in. × 4½in. × 1in. Complete with batteries and 3 sub-miniature valves, earpiece and cord. Only two controls; volume and on/off. Fitted with internal crystal microphone.

MADE TO SELL FOR 22 GNS.

LASKY'S PRICE Postage 3/6 extra. **99/6**

Ready for use. Perfect working order. Slightly soiled but new and unused.

HUGE PURCHASE OF STAINLESS STEEL RECORDING WIRE. ON STANDARD REELS.

(By B. & H.)

15 mins.	7/6
30 mins.	12/6
60 mins.	25/-

Postage 1/- per reel.

SOLON SOLDERING IRONS

220-250 volts

Latest model instrument iron	19/8
Standard model	19/-

ALL WAVE RADIO INTERFERENCE SUPPRESSOR UNITS, 5/6 each.

JACK PLUGS AND SOCKETS

Standard size 3/11 per pair.

THE SOUNDMASTER

You can now build your own **HIGH FIDELITY TAPE RECORDER** (both tape deck and amplifier) **AT HOME.** Uses precision machined parts and standard radio components. Easily wired and assembled without previous experience.

SEND NOW for 26 page booklet giving full data to build in 6 easy stages, with full size wiring diagrams. All the latest developments in home recording. Lifelike reproduction of voice, music and events. 3 speeds, twin track recording at 3¾in., 7½in. and 15in. per second. Fast forward and fast rewind using 3 motors.

POST FREE **6/6**

BY THE CREATORS OF THE VIEWMASTER

All components in stock. Write for list.

Wearite, Bulgin, T.C.C., Collaro, etc.

SENTERCEL RECTIFIERS

RM1	3/10
RM2	4/3
RM3	5/-
RM4	18/-

WESTINGHOUSE RECTIFIERS

250 v. R.M.S.

14A976. 80 m/a 8/6.

14A86. 200 m/a. 20/4.

14A100. 270 v. R.M.S. 200 m/a. 21/6.

PRESS BUTTON COIL PACKS

5 Preset stations—3 M.W. and 2 L.W. For use in superhet circuit, with 460 Kc/s. I.F. Size: 3¼in. × 5¼in. 2¼in. Deep. By Famous Manufacturer, complete with circuit, and knobs.

LASKY'S PRICE 21/-. Postage 2/6.

TANNOY PRESSURE UNITS

10 watts. 7.5 ohms impedance. Last few only. **PRICE** Carriage 4/6 extra. **59/6**

MICROPHONE STANDS

Table model. 2-section chrome plated. Crackle finish base. **15/-**

Floor model. 2-section. Brass, heavily chrome plated Carriage 2/6 extra. **59/6**

GRAM MOTORS Shaded Pole

Rim drive, synchronous. For 200-250v. 50 c.p.s. Many uses. 9/6.

METAL RECTIFIERS

6 and 12 volt F.W. Bridge.

0.6a.	4/6
2a.	9/-
3a.	9/11
4a.	12/-
6a.	17/6

6 volt Centre Tapped Bridge.

0.75a.	3/9
1a.	3/11

CONDENSERS. Electrolytics.

Cans

16 mfd. 300 v.w.	3/6
24 mfd. 450 v.w.	3/11
32 mfd. 500 v.w.	5/11
60 mfd. 350 v.w.	3/6
64 mfd. 450 v.w.	4/11
8+8 mfd. 450 v.w.	3/11
8+16 mfd. 450 v.w.	5/11
8+32 mfd. 475 v.w.	5/11
16+8 mfd. 500 v.w.	4/6
16+16 mfd. 500 v.w.	4/6
16+32 mfd. 450 v.w.	4/9
20+20 mfd. 275 v.w.	2/-
32+32 mfd. 500 v.w.	4/11
32+32 mfd. 350 v.w.	5/11
60+100 mfd. 350 v.w.	7/6
250 mfd. 350 v.w.	4/11
8000 mfd. 3 v.w.	6/11

Tubular

1 mfd. 200 v.w.	1/-
1 mfd. 500 v.w.	1/-
2 mfd. 150 v.w.	1/-
2 mfd. 350 v.w.	1/6
4 mfd. 350 v.w.	1/3
4 mfd. 450 v.w.	1/6
8 mfd. 150 v.w.	1/6
8 mfd. 350 v.w.	2/-
8 mfd. 450 v.w.	1/9
15 mfd. 200 v.w.	2/-
16 mfd. 350 v.w.	2/3
16 mfd. 450 v.w.	2/9
16 mfd. 500 v.w.	3/3
32 mfd. 350 v.w.	3/6
32 mfd. 450 v.w.	4/9
50 mfd. 350 v.w.	4/6
250 mfd. 12 v.w.	2/-
8+8 mfd. 350 v.w.	3/-
8+8 mfd. 450 v.w.	5/11
18+18 mfd. 350 v.w.	2/6

MANY OTHER TYPES IN STOCK

R.1155 RECEIVERS

BRAND NEW AERIAL TESTED BEFORE DESPATCH

These well-known ex-Air Ministry Receivers need no further introduction.

Supplied complete with 10 valves.

LASKY'S PRICE **£11.19.6**

USED MODELS **£7.19.6**

A Few Only. **Model R1155.N.** Covering the shipping band of 1.5-3.0 Mc/s. Price £17.

Carriage 12/6 per unit extra, including 10/- returnable on packing case.

10s. 0d. rebate will be given on power packs for the R.1155 when purchased with the receiver.

Fully Assembled Power Pack and Output Stage, for R1155 Receiver For use on 200-250 volts A.C. mains.

LASKY'S PRICE Carriage 5/- extra. **79/6**

SPECIAL T.V. CONDENSERS

32 + 100 mfd. 450 v.w. 7/6 .04 mfd. 12.5 Kv. 7/6

Bias

10 mfd. 25 v.w.	1/3
12 mfd. 50 v.w.	1/3
25 mfd. 25 v.w.	1/6
25 mfd. 50 v.w.	1/6
50 mfd. 12 v.w.	1/3
50 mfd. 25 v.w.	1/6
50 mfd. 50 v.w.	1/9
75 mfd. 12 v.w.	1/-
100 mfd. 25 v.w.	2/-
100 mfd. 50 v.w.	2/6

High Voltage

.1 mfd. 2.5 Kv.	2/6
.1 mfd. 3 Kv.	3/6
.1 mfd. 3.5 Kv.	4/6
.1 mfd. 10 Kv.	12/6
.25 mfd. 2.5 Kv.	5/6
.1+.1 mfd. 3.5 Kv.	5/11

Tubular Waxed

500 v.w., .01, .02, .05, .001, .002, .005, etc. From **6d.** each, 5/- doz. .1 mfd. **9d.** each.

Miniature Mica

100, 200, 300, 500 PF., **5d.** each, 4/- doz.

T.C.C. VISCONOL HIGH VOLTAGE CONDENSERS

(Cathodray)

.001 mfd. 12.5 kV.	7/6
.001 mfd. 15 kV.	10/-
.001 mfd. 25 kV.	18/-
.0005 mfd. 25 kV.	18/-
.0005 mfd. 12.5 kV.	10/-

Plastic case, single bolt fixing. Other h.v. types.

.1 mfd. 7 kV.	15/-
.04 mfd. 12.5 kV.	7/6

MUIRHEAD SLOW MOTION DRIVES 8/6

CRYSTAL DIODES

Germanium 1/6 each, post free.

12 VOLT D.C. MOTOR GENERATORS

Output 300 volts at 150 m/A. D.C. 7,500 r.p.m. Size: 2¼in. diam. 6in. long.

LASKY'S PRICE **17/6**

I.F. TRANSFORMERS

465 Kc/s Iron dust cores in cans, midget type. Size 1½in. x 1in. x 2½in. By Plessey. Price 8/6 per pair.

WEARITE TYPE 550. 445-520 Kc/s. 8/6 per pair.

WEARITE TYPE 500. 450-470 Kc/s. 8/6 per pair.

TOGGLE SWITCHES. BULGIN

S.P.S.T.	1/6
D.P.S.T.	2/6
D.P. Change over	3/6

12 VOLT VIBRATOR UNITS

Output 230 volts 80 mA. BRAND NEW AND UNUSED. Size: 9 × 5 × 5¼in. Supplied less vibrator. Vibrator required is 6-pin synchronous.

LASKY'S PRICE **19/6**

Carr. 3/6 extra.

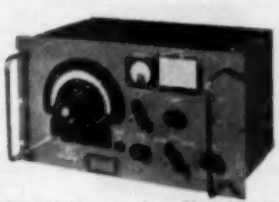
Other types in stock from 15/-.

BRANDENBERG R.F. E.H.T. UNITS

Complete with valves.

6-9 Kv.	£6	6	0
13-16 Kv.	£9	9	0

R.1132.A RECEIVERS

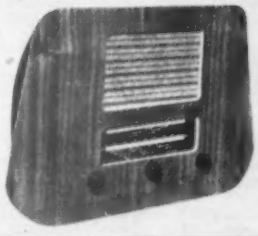


Supplied in maker's original wood transit case. Frequency coverage 100-124 Mc/s. 11 valves: 1 VR65, 1 VR66, 4 VR53, 2 VR54, 1 6J5, 1 VS70, 1 VR57. Large tuning scale with slow motion drive. 0-5 mA. tuning meter. R.F. and L.F. gain controls, jack sockets for line and 'phone. Totally enclosed in metal case, grey enamelled with plated handles. Size: 18 × 10 × 11in. Supplied with all valves, also circuit and calibration chart.

GRADE 1. Brand New 79/6. **GRADE 2.** Soiled 49/6

GRADE 3. Secondhand 39/6. Carriage 10/- per unit extra.

BAFFLE RADIO CABINETS



Pleasing design, complete with knobs, drilled chassis, dial, drum drive and back. Finish in satin mahogany veneer, natural colour polish. Outside dimensions: 17½in. wide 11½in. high, 5in. deep.

LASKY'S PRICE

36/6

Carriage 2/- extra.

TWO-GANG TUNING CONDENSERS .0005MFD.

No. 1. Miniature. With trimmers. Size: 1½in. × 2in. × 1½in., ¼in. spindle. **LASKY'S PRICE, 8/6**

No. 2. Midget. With trimmers. Size: 2½in. × 1½in. × 1½in., ¼in. spindle. **LASKY'S PRICE 8/6.**

No. 3. Midget. Less trimmers. Size: 2in. × 1½in. × 1½in., ¼in. spindle. **LASKY'S PRICE 6/6.**

No. 4. Standard type. Size: 2½in. × 2½in. × 1½in., ¼in. spindle. **LASKY'S PRICE 6/6.**

A LASKY'S RADIO ADVERTISEMENT. SEE OVER.

LASKY'S RADIO

LINE TRANSFORMERS FOR "ETRONIC" T.V. RECEIVERS

No. 1. For models 1536 and 1637. Complete with EY51 rectifier, 39/6.
No. 2. 7Kv. type, 35/-.

POT/METERS. All values. Wire Wound from 3/6. Depending on wattage and length of spindle. **Carbon.** Less switch 3/3 each. With s.p. switch .... 4/3 each. With d.p. switch .... 5/6 each.

VCR97 C.R. TUBES, new unused. 35/-. Carriage 5/-.

Screen Enlarger for VCR97. Filter type, 17/6. Postage 2/6.

BASES for VCR97, 2/6.

C.R.T. Neck Protectors, 2/6.

10 K.V. METROSIL E.H.T. REGULATORS. By Metrovick. Pencil type, 5/- each.

TELEVISION SELENIUM RECTIFIERS
The very latest "Sentercell" S.T.C. range:
K3/40, 3.2 kV. 7/6
K3/45, 3.6 kV. 8/2
K3/50, 4.0 kV. 8/8
K3/100, 8.0 kV. 14/8
K3/160, 12.8 kV. 21/6

DARK SCREEN FILTERS
18in. × 14¼in. 25/-
14¼in. × 12¼in. 19/6
13¼in. × 11in. 14/11

PERSPEX. 13¼in. × 10¼in. × ⅛in. Neutral shade, slightly marked, 4/11 per piece.

TEST PRODS
Fully fused, with retractable points, 4/11 per pair (1 red, 1 black).

9in. TABLE T.V. CABINETS

Medium shade mahogany finish. Complete with back, safety glass, speaker-fret. Internal dimensions: 19¼in. high, 16in. wide, 14in. deep.

LASKY'S PRICE
Boiled 25/-
Carriage 7/6 each extra

Adaptor frame available for 6in. C.R. tubes. The aperture can easily be enlarged to take 12in. or 14in. tubes.

SPECIAL C.R.T. OFFER
Brand new and unused 12in. ion trap cathode ray tubes. 6.3 volt heater, 7-9 Kv. E.H.T., 35 mm. neck. Black and white picture. By famous manufacturer.
PERFECT **£12/19/6**
Carriage and insurance 15/- per tube extra.

MANUFACTURERS' SURPLUS T.V. COMPONENTS
Wide Angle Scanning Coils. Low imp. line and frame .. pair 19/6
Scanning Coils. 35 mm. Low imp. line and frame 12/6
Frame multi ratio output trans. 10/6
Focus Coil. 35 mm. electro magnetic 12/6
Line or Frame B.O. transformer. Auto.. 4/6
P.M. Focus Magnets. With vernier. 35 mm. Tetrode 15/-
Triode 17/6
Wide Angle P.M. Focus Unit. All 38 mm. tubes. With vernier and picture shift 25/-

PLESSEY
Scan coils per pair 25/-
Width Control..... 6/6

NOW AVAILABLE LARGE SCREEN WIDE ANGLE CONVERSION DETAILS FOR THE VIEWMASTER
Send 3d. stamp for full data. Fully itemised price list of all Viewmaster components now available.

Co-Axial Cable. 70-80 ohms impedance.
Single core, 9/- doz. yards.
Twin core, 12/- doz. yards.
Twin feeder, 6/- doz. yards.
Co-Axial Connectors. For standard ¼in. cable, 1/11.

WIREWOUND POT. METERS.
Type 901. Most values. 2/6 each.

C.R.T. MASKS
Brand New
LATEST ASPECT RATIO
9in. 7/-
10in. 7/6
12in. 15/-
12in. Flat Face..... 15/-
12in. Old ratio 9/6
12in. Plastic, with dk. sc. filter and gold finish escutcheon .. 17/6
14in. Rectangular .. 21/-
16in. Eng. Elect. 42/-
16in. Double D .. 31/6
16in. With dark screen filter and gold finish escutcheon 32/6
17in. Rectangular .. 21/-
SOILED. NEW ASPECT RATIO
9in. 5/-
12in. 7/6
12in. with fitted armour plate glass, cream 11/6
12in. do. Black 8/6

ARMOUR PLATE GLASS
16in. Actual size 17¼ × 15½ × ¼ inch 7/11
15in. Actual size 16½in. × 13in. × ¼in. 6/11
12in. Actual size 13in. × 10¼in. × ¼in. 4/-
9in. Actual size 9in. × 8in. × ¼in. 3/-

DE LUXE T.V. CABINETS

NEW 1954
12 INCH MODEL
(Mark II)

This cabinet is now supplied complete with mask, glass, castors, shelf, bearers, c.r.t. neck and protector, back, speaker fret and baffle board. Finished in beautiful figured medium, light or dark walnut veneer, with high polish. Suitable for most home constructor T.V. receivers, including the "Viewmaster," "Practical Television," "Tele King," "Magniview," "Wireless World," etc. Can be supplied with cut-out for 16in. c.r. tube at no extra cost.

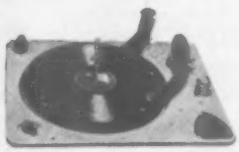
WHY NOT CONVERT YOUR TABLE RECEIVER TO A CONSOLE MODEL
Adaptor frames for fitting 9in. or 10in. c.r. tubes can be supplied if required.

LASKY'S PRICE
Carriage 12/6 extra. **£8.10.0**

An allowance of 4s. 6d. will be made if the mask is not required.
Mask and glass extra when cabinet is ordered with cut out for 14, 16, or 17in. C.R.T.'s.
Inside Dimensions: Depth 16½in.; width 17½in.; height 28in. Overall height 32in. and width 18½in.

THE VIEWMASTER
Construction envelope 7/6. POST FREE.
All components in stock. Write for price list.

COLLARO 3-SPEED AUTOMATIC RECORD CHANGERS
MODEL 3RC/521.



Brand new and unused in maker's original carton. Pleasing cream or fawn finish. Complete with hi-fidelity studio crystal turnover head. Type GP. 29.

LASKY'S PRICE
£9.19.6
Carriage Free

NOW IN STOCK. 3-Speed Mixer Changer model 3RC/522. Price on request.

TYPE AT/9 T.V. MAINS AUTO TRANSFORMER
200, 220, 250 and 375 volt tappings. 250 mA. Also 5 v. 3 a.; 6.3 v. 7 a., and 6.3 v. 3 a. secondaries. Price 25/-.

INTERCOM UNITS
4-station operation. For use on A.C./D.C. mains 200-250 volts. Supplied complete, with 3 new valves, ready for immediate installation. Fitted in attractive plastic cabinet.
Suitable for use as baby alarm.
MASTER UNIT £5/19/6.
Carr. 5/- extra.
Extension Units. Price 21/- each complete. Carriage 2/- each extra.

LASKY'S LINE TRANSFORMER
RF.EHT for line fly-back. 6-8Kv. with EY51 heater winding. Suitable for home construction T/V 19/6 each.

POSTAGE STAMP TRIMMERS
Paxolin. Up to 100pf. 6d. each. 5/- per doz.
Ceramic. Up to 100pf. 9d. each. 7/6 per doz.

Duodecal (B12A) bases. VCR139 c.r.t. bases. 1/- each. 10/6 dozen.

ELAC DUOMAG FOCALISERS. For wide angle c.r. tubes. Low, medium and high flux. 37/6 each.

THE TELE-KING

A practical 5-channel

SUPERHET TELEVISION RECEIVER

16" **17"**

Using the new 16 and 17 inch cathode ray tubes and wide angle components for the home constructor.

Complete instructions, wiring diagrams and 32-page descriptive booklet.

6/= POST FREE

ALL COMPONENTS IN STOCK
WRITE FOR LIST

ALLEN WIDE ANGLE COMPONENTS

D.C. 300 latest type Ferroxcube Coils 39/6
GL. 16 Coil 7/6
GL. 18 Coil 7/6
Focus Coil 31/-
FO.305 trans. 21/-
Frame B.O. transformer 15/-
Line EHT. transformer 40/-

CHASSIS

Power pack Sound-vision and Scan chassis. PRICE 11/- each. All other metal work available from stock.

CONDENSERS

All condensers as specified. Manufacturers' surplus £3/16/-.

COILS 13 all exactly as specified. Price 44/6.

RESISTANCES. 72 Resistances, all exactly as specified, 18/-.

CABINET

Walnut veneer, £8/10/-, plus carriage 12/6 extra. As illustrated here.

WIDE ANGLE CATHODE RAY TUBES

14in. MW36-22 ..	£19	9	3
14in. C14B	£20	10	1
16in. MW41-1	£22	4	10
16in. T901	£22	4	10
17in. MW43-64 ..	£23	12	8
17in. C17BM	£24	13	0

Carriage and insurance extra.

OUTPUT TRANSFORMERS

40 mA Multi ratio 4/11
80 mA Multi ratio 14/11
80 mA Pentode 12/6
60 mA Plessey, 6,000 ohms.. 5/11
Standard Pentode 4/11
Pentode 3/6
Midget Pentode 3/6
Miniature Pentode, 3S4, 1S4 4/6
PX4 Intervalve 8/6
5 : 1 Intervalve..... 5/11

P.M. LOUDSPEAKERS

All with 3 ohm speech coil

2½in. 18/- 4in. 9/6 6½in. 13/6
3in. 12/6 5in. 14/6 8in. 15/-
10in. 17/6

NEW AVAILABLE 12-inch Goodmans heavy duty speaker. Capacity 15 watts, 15 ohms speech coil impedance.

LASKY'S PRICE £5/19/6. Car 3/6 ex. All loudsprs. offered are first grade and of highest quality construction. Many other types in stock. Send us your reqts. Special offer. 12in. Truvox, 3 ohms. **LASKY'S PRICE 49/6.**

LASKY'S T.V. CONSTRUCTORS' PARCELS

No. 1. All brand new components by Igranic. Comprises E.H.T. flyback line transformer, 7-10Kv. with ferroxcube core and rectifier heater winding; scanning coils; frame output transformer; Elac focus unit with vernier adjuster, U37 E.H.T. rectifier and brand new 12-inch cathode ray tube with ion trap, mask and glass. **LASKY'S PRICE FOR THE COMPLETE PARCEL, £15/19/6.** Carriage and insurance 15/- extra.

No. 2. The Constructors' Parcel as above, but less the cathode ray tube and ion trap. **LASKY'S PRICE 79/6.** Carr. 3/6 extra.

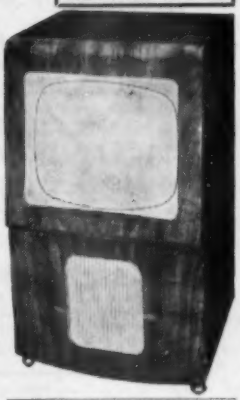
No. 3. Condenser Parcel. 1 of each :—.04mfd. 12.5Kv.; 32 +32mfd. 350 v.w.; 32+100mfd. 450 v.w. AND 24 1,000pf. ceramic tubes; 6 .1mfd. 500 v.w.; .01mfd. 500 v.w. ALSO 12 assorted "pf" condensers of your own choice. **PRICE 45/-.** POST FREE.

No. 4. Complete set of metalwork, as illustrated here. Unassembled. Comprising main chassis, tube supports and valveholders. (Less sound-vision chassis.) **PRICE 25/-.** Carriage 3/6 extra.

No. 5. RESISTANCES. ½ Watt. 85 resistances your choice. **PRICE 18/-.** POST FREE.

No. 6. One of each of the following :—Ion tap 1T6; Duodecal tube holder; low impedance line and frame scanning coils. **PRICE 15/-.** Postage 1/6 extra.

Alexandra Palace, Sutton Coldfield, Holme Moss, Wenvoe, Pontop Pike, Belfast, Kirk o'Shotts.



SPEAKER FRET

Expanded Metal. Silver Finish.
12in. × 12in. 3/11
12in. × 18in. 5/11
Plastic White, 12in. × 5in... 2/-
Wire, Bronze, 11in. × 8in... 2/-

SPECIAL FOR TAPE RECORDER CONSTRUCTORS. COMBINED RECORD/PLAYBACK AND ERASE TAPE RECORDER HEAD. PRICE 53/6. Postage 1/6 extra.

MU METAL SCREENED INPUT TRANSFORMER. PRICE 61/-. Postage 1/6 extra.

TAPEMASTER HEADS

Senior Record/playback .. 45/-
Erase 45/-
Junior Record/playback .. 39/6
Erase 39/6

15in. Cream rubber c.r.t. masks 17/6. Postage 2/- extra.
15in. Cream rubber masks fitted with armour plate glass, 22/6. Postage 2/6 extra.

NOTICE TO ALL PURCHASERS OF THE ENGLISH ELECTRIC 16 inch C.R.T. TYPE T.901

The first and only reconditioning service. By English Electric. A reconditioned 16in. metal tube costs **£12** and carries maker's full guarantee. Write for further details.

MAINS TRANSFORMERS

All 200-250 v. 50 c.p.s. primary. Finest quality, fully guaranteed.
M.B.A./3. 350-0-350 v. 80 mA., 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. Price 18/-.
MBA/6. 325-0-325 v. 100 mA. 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price 22/6.
MBA/7. 250-0-250 v. 80 mA., 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. Price 18/-.
MBA/8. 235-0-235 v. 60 mA., and 6.3 v. 3 a. Price 12/6.
AT/3. Auto transformer. 0-10-120, 200-230-240 volts 100 watt. Price 17/6.

FILAMENT TRANSFORMERS

6.3 v. 1.5 a., 5/9.
6.3 v. 3 a., 9/6.
6.3 v. tapped at 4 v. 2 amps., 7/9.
Special Transformer. 2 amps. with the following tappings: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts. Price 17/6.

SMOOTHING CHOKES

20 mA. 40 H 3/6
40 mA. 8 H..... 3/6
40 mA. 10 H 4/3
100 mA. 10-20 H 7/3
250 mA. 10 H..... 18/6

THE "UNIVERSAL" LARGE SCREEN AC/DC TELEVISOR

By A. S. Torrance, A.M.I.P.R.E., A.M.T.S.

A 28-page booklet giving full instructions for building a large 17-inch screen televisor.

* A.C. and D.C. mains.
* P.M. focussing.
* Mullard valves and c.r. tube.
* 5-channel superhet.
* Table model.
* Convertible into radiogram console.
* Incorporates all latest developments.

3d. POST FREE.

No. 7. One of each T.V. Mains auto-transformers (type AT/9), 60+100mfd. 350 v.w. condenser; 5H 250 mA. choke; 14A100 rectifier. **PRICE 60/-.** Carriage 2/6 extra.

SPECIAL OFFER

Scanning coils, low impedance line and high frame, and electro magnetic focus coil, high impedance. For use with c.r. tubes with 38mm. neck. **LASKY'S PRICE 27/6.** POST FREE.

COIL PACKS Medium and 2 short wave bands. Price 16/-.

Long, medium and short wave bands. 29/6.

RF25 UNITS. New, with valves, 19/11. Carriage 2/6.

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370 HARROW ROAD, PADDINGTON, LONDON, W.9

(Opposite Paddington Hospital)

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TERMS: Pro forma, Cash With Order or C.O.D. on post items only. Postage and packing on orders value £1—1/- extra: £5—2/- extra; £10—3/6 extra. Over £10 carriage free, unless specifically stated otherwise.

Prices slashed at Clydesdale

F24 AIRCRAFT CAMERA in Transit Case.

Full Details.
Lens 5in. f/4 with internal iris diaphragm stops to f/11, fixed focus set at infinity, screw-in housing project 5¼in. Focal plane shutter, speeds 1/60th to 1/1,000th of a second and time, fitted in film magazine designed for 5¾in. wide film, picture size 5¼ x 5¼in. Shutter release and rewind spindle fits standard spanner. Hand operated as it stands. Nett. weight 17lb. Packed in fitted transit case 42lb. Dimensions: body 6½ x 9 x 9½in., overall including lens housing 11¾in. x 9in. x 9½in. Provision for external motor drive (not supplied). Lens housing grooved for fitting to aircraft camera port. A precision Air Survey Camera, could be adapted for Laboratory, Industrial or Portraiture use.

ASK FOR X/H302 — **£4.19.6** — CARRIAGE PAID

F24 AIRCRAFT CAMERA
In Transit Case.
With 8in. f/2.9 lens, otherwise as H.302.

ASK FOR X/H300 — **£9.19.6** — CARRIAGE PAID

14in. f/5.6 LENS FOR F24 CAMERA
Complete with Iris, Filter, Mount and Extension. In transit case.

ASK FOR X/H563 — **£6.19.6** — CARRIAGE PAID

F46 CAMERA IN TRANSIT CASE
Lens 5in. f/4 with internal iris diaphragm stops to F/11 with filter. Fixed focus at infinity, bolted lens housing projects 2¼in. Venetian Blind type shutter, speeds time and instantaneous. Fully Motor Driven including film winding. Film magazine takes size "20" film. Picture size 2¾in. x 7 5/16th in. Nett weight 13½lb., packed in transit case 23lb. Dim.: body 7in. x 11in. x 3¾in. Body keyed for fitting keyway on vessel, a magnifying prism is also fitted, original purpose to record time of exposure from clock (not supplied) inside chamber, 24 volt Motor and electrical system for illumination of interior of clock chamber and camera body, also prevention of condensation.

ASK FOR X/H73 — **£4.9.6** — CARRIAGE PAID

RECORDER MK. II 24 VOLTS
This unit is an Auto Camera for 16 mm. film, the shutter can be operated at single shot or one frame per half-second continuously. The Recorder requires a cassette, or Magazine (not supplied) to hold 25ft. of 16 mm. film. The Optical Unit has an f/4.5 lens and Prism Reflector system, for right angle operation through the side of the case. There is also an Iris Control for Dull or Bright Exposures and a Film Footage Indicator. The whole unit is powered by a 24-volt Motor, which consumes only 0.5 of an amp. Dimensions 4¾in. x 4in. x 1in.
Contained in Transit Case. Dimensions 9½in. x 6in. x 2½in.
USED GOOD CONDITION

ASK FOR X/H883 — **27/-** each — POST PAID

RECORDER MK. II. 24 VOLTS
As above. Less Transit Case.

ASK FOR X/H883A — **22/6** each — POST PAID

ONLY AVAILABLE with Recorder Mk. II
Film Cassettes, 25ft. Capacity.

ASK FOR X/H960 — **10/-** each — POST PAID

We are unable to supply external fittings or films for these Units at present.

CANADIAN R.E.L. BINOCULARS
Brand New and Guaranteed optically perfect. Individual eye-piece focussing (dioptar setting) and variable inter-ocular setting, leather neck strap.
In original cartons.
Magnification 6X30.

ASK FOR X/H920 — **£8.19.6** each — POST PAID

In fitted leather case.
Magnification 7X50.

ASK FOR X/H921 — **£21.10.0** each — POST PAID

PLOTTER FIELD MK. IV. Ref. OS.739A.
A precision made Protractor Unit, first-class condition. With 2 scales 0-180 deg. moving crossarms, scaled 21-65 each 12¾in. long. Straight edge base scaled 0-3,500 length 25in. fully extended. In soiled leather case 16 x 5½ x 2in.

ASK FOR X/H864 — **9/11** each — POST PAID

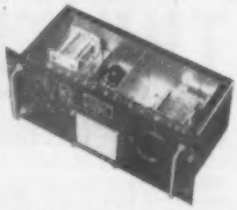
FOR EXPORT ONLY
WIRELESS SET NO. 38 MK. II
Range 7.7-9 Mc/s, 5 valves and all accessories. Complete (less batteries) and unused in original wood case. Four complete units per case.

ASK FOR X/HS19/4 — **£20.0.0** — PER CASE OF 4 SETS
F.O.B. GLASGOW.

POWER MODULATION UNIT
For the WS.36 Transmitter.
An A.C. mains power unit with built-in modulator. Input 110-250 v. A.C. 50 c/s, Mains providing H.T. and L.T. output, 3 transformers, L.T. 4 v. 4 a., 3.25-0-3.25 v. 8 a. HT (1) 200-0-200 v. 50 mA. HT (2) 500-0-500 v. 200 mA and 500-0-500 v. 200 mA, fully rectified and smoothed valves 3/6C5, 2/807, 2/AV1 (FW4/800) built in a varnished wood case with carrying handles. Dim. : 22½ x 16½ x 14½in.

ASK FOR X/H43 — **£6.17.6** each — CARRIAGE PAID

TRANSMITTER TUNING UNITS
Each having Vernier tuning dial, Variable Capacitor, Tank Coil unit on ceramic former, Ceramic Switch, etc., etc. In metal cabinet 17½ x 7½ x 8in. Finish black. Unused, but externally soiled, scratched and dented, due to being Loose Stored.



TU.7B Range 4,500-6,200 Kc/s. Ask for X/H29.
TU.8B Range 6,200-7,700 Kc/s. Ask for X/H30.
TU9B Range 7,000-10,000 Kc/s. Ask for X/H467.

EITHER UNIT — **10/-** each — CARRIAGE 2/- EXTRA

BC-456 SPEECH MODULATOR UNITS
Part of SCR-274-N. "Command" Equipment.
(U.S.A. made)
Complete with valves 1625, 1215 and VR150/30. Transformers, Relays, etc., less dynamotor. Overall dim.: 10½ x 7½ x 4½in. Loose stored.

ASK FOR X/E42 — **27/6** — CARRIAGE PAID
Circuit 1/3

IFF RECEIVER R3108. Ref. No. 10DB/505
Contains: Motor Generator input 12V. 3.8A. Output 480V. .04A. D.C. with a gearbox operating a switching mechanism to detube the receiver at time intervals. Data available for converting to 250 v. 50 c/s use as motor.
Plus: 4/VR65A (SP.41) 2/VR92 (EA50), 2/CV6 (Det. 20). Valves, etc., etc.
Metal Case: Dim.: 12 x 12 x 8in. Wgt. 24lb.

ASK FOR S/H961 — **19/6** each — CARRIAGE PAID

26 WATT OUTPUT TRANSFORMER
Parmeko type AF5084/1A. (Mfg. Surplus).
Primary: 6,600 ohms C.T. Sec.'s. 3.5, 5, 7.5 or 10 ohms. Dim.: 3¾ x 2¾ x 3¼in. Fully shrouded. Wgt. 3lb.

ASK FOR X/H565 — **19/6** each — POST PAID

DRIVER TRANSFORMER
For ET-4336 TRANSMITTER
Ref. No. 110K/117 part XT-3202. Centre tapped primary inductance 3.4 henries. Two secondaries inductance 14 henries each. Ratio whole pri. to one sec. 1-2 approx. Dimensions 4½ x 3½ x 3¼in. Wgt. 6lb. 4 hole fixing.

ASK FOR E562 — **18/6** each — POST PAID

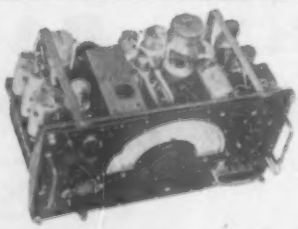
T1154B TRANSMITTER UNIT
Medium/high powered for C.W.-M.C.W. R/T, 3 ranges 10-5.5 Mc/s., 5.5 Mc/s., 500-200 kc/s. Complete with 4 valves, etc., in metal case 14 x 16½ x 8½in. External power supply required.

ASK FOR X/E5A — **39/6** each — CARRIAGE 7/6 EXTRA
Circuit 2/3.
ALSO AVAILABLE
T1154B Unit, less Valves, but otherwise complete.

ASK FOR X/E5B — **15/-** each — CARRIAGE 7/6 EXTRA

VISUAL INDICATOR
TYPE I, Ref. 10Q/2
Dual reading left/right D.F. meter for R1155, 2¾in. scale, overall dim.: 3½ x 2¼in. In used condition.
Ask for X/H862A

12/6 each
Post Paid



POWER UNITS FOR T1154/R1155 UNITS
Types 33 or 33B. Input 24 v. D.C. 16 a. Output 1,200 v. D.C. 200 mA. Ask for X/E7A.
Types 35 or 35A. Input 18 v. D.C. 12 a. Output 7.2 v. D.C. 13 a. and 225 v. D.C. 110 mA. Ask for X/E8A.
Each a motor generator unit, smoothed, etc. In metal case 16 x 7½ x 6in.
LOOSE STORED

ANY UNIT — **42/6** each — CARRIAGE PAID

R.1155 RECEIVER UNIT
Communications, D.F and "Ham" 20, 40, 80, 5 ranges 18-7.5 Mc/s, 7.5-3 Mc/s., 1,500-600 kc/s., 500-200 kc/s, and 200-75 kc/s. Complete with 10 valves, S.M. Drive, M.E. tuning, B.F.O., etc., in metal case 16½ x 9 x 9in. External power supply required. APPEARANCE AS NEW.

ASK FOR X/E6 — **£8.19.6** — CARRIAGE PAID
APPEARANCE ROUGH

ASK FOR X/H898 — **£5.19.6** — CARRIAGE 7/6 EXTRA
Circuit 1/3

Still Available as detailed in Previous Issues

EX-R.N. GAUSS INDICATION AND RANGE METER APS6156
Made by E.T.E.I. Ltd., for use with a fluxmeter. Measuring head for 0.625in. gap. Dim.: Overall 3½ x 2 x 1½in. with leads in wood box 6½ x 3½ x 2in.
ASK FOR X/E345 — 4/6 each — POST PAID

AUDIO FREQUENCY OSCILLATOR
A.C. mains operation 230 v. 50 c/s. input with 6 valves 3/6J5G, 2/EL32, 5Z4G, 2 mains transformers, etc., 3 audio ranges 100-1,500 cps., calibrated dial, motor tuning, 20 v. A.C. motor fitted. The whole built in an enclosed metal cabinet with shock mounts. Dim.: 21 x 15 x 10. Finish grey. Used, good condition.
ASK FOR X/H793 — £7.19.6 each — CARRIAGE 7/6 EXTRA

FLUXMETER TYPE 1, WY.0023

Designed to determine the polarity of Magnets. Complete with probe. ranges 500/1000, gauss, 1000/2000 gauss, 2000/4000 gauss, M/C Meter and instruction leaflet. Less battery (1.5 v.), in wood case with hinged lid and handle. Dim. 12½ x 9 x 6in.
ASK FOR X/H361 — 55/- each — CARRIAGE PAID

ELECTROSTATIC KILOVOLTMETER
Range 0/2 kV 2½in. round mid. Case, drilled flange.
ASK FOR X/E333 — 35/- each — POST PAID

500 MICROAMP METER. Ref. ZN2186
For WS-18 Transmitter
2in. round, clip mounting case. Res. 500 ohms.
ASK FOR X/E303 — 15/- each — POST PAID

WAVE FORM GENERATOR TYPE 26
With valves VR55, 2/VR54, VR116, 3/VR56, 6/VR65, 2 relays, plus cond., etc. Input 80 v. 2,000 c/s. A.C. In metal case 12 x 7½ x 11½in.
ASK FOR X/H884 — 21/- each — CARRIAGE 2/6 EXTRA

TEST SET SE2 PATTERN NO. W5799
Brand New
ASK FOR X/H937 — £3.19.6 each — CARRIAGE PAID

CALIBRATOR UNIT R.D.F. No. 1 ZA-14401
In original wood case.
ASK FOR X/H829 — 21/- each — CARRIAGE PAID

TEST OSCILLATOR TS-24/ARR-2
(U.S.A. made)
ASK FOR X/H364 — 21/- each — CARRIAGE PAID

TEST OSCILLATOR TS-24A/ARR-3
(U.S.A. made)
ASK FOR X/H364A — 27/6 each — CARRIAGE PAID

TEST SET TYPE 102
ASK FOR X/H561 — 21/- each — CARRIAGE PAID

MODULATOR 189
BRAND NEW. In original wood case.
ASK FOR X/H713 — 21/- each — CARRIAGE PAID

GYRO ANGLING POWER UNIT 9/2201
ASK FOR X/E874 — 12/6 each — POST PAID

MONITOR CRYSTAL TYPE 2, 10T/11390
Less valves and crystals.
ASK FOR X/H872 — 5/- each — POST 1/- EXTRA

MAGNETIC MARCHING COMPASS, MK. I
ASK FOR X/H406 — 12/6 each — POST PAID

RECEIVER UNIT TYPE 25
REF. 10P/1L
ASK FOR X/H299 — 35/- each — POST PAID

WS-18 RECEIVER CHASSIS
ASK FOR X/H22 — 25/- each — POST PAID

WS-18 TRANSMITTER-RECEIVER CHASSIS Partly stripped by M.O.S.
ASK FOR X/H349 — 33/6 each — POST PAID

RECEIVER CHASSIS, RANGE 150-200 Mc/s
Contains 3/955 Acorn Valves.
ASK FOR X/H940 — 21/- each — POST PAID

SUPPLY UNIT RECTIFIER
For No. 43 Transmitter.
Ex. Cdn. Army in original wood case. A.C. 50/60 c/s. 1.7 kVa.
ASK FOR H26 — £25 each — CARRIAGE PAID

SELSYN MOTOR TYPE 5J/2512
Ref. No. W.325A
230 volts A.C. input single phase.
ASK FOR X/H83 — 39/6 each — CARRIAGE PAID

POWER UNIT TYPE 266
In transit case.
Input 80 v. 1.5 c.p.s A.C.
ASK FOR X/E870 — 22/6 each — CARRIAGE PAID

AERIAL SYSTEM TYPE 62
U.H.F. Antenna on streamlined moulding with VR92 (EA50) untuned detector stage. Overall dim.: 13 x 4½ x 2½in. Antenna 22.5 cm.
ASK FOR X/H496 — 3/6 each — 9d. POST EXTRA
Circuit 1/3 each.

STAINLESS STEEL AERIAL WIRE
7/.015in. reels of approx. 1,600ft. made by Temco.
ASK FOR X/E143 — 25/- per reel — CARRIAGE PAID

DINGHY TELESCOPIC MAST
Aluminium Telescopes from 14¼in. to 7¼ft. Seven sections, base dia. ¾in. Wgt. 4 oz.
ASK FOR X/H489 — 4/6 each — 6d. POST EXTRA

COOLANT PUMP by Packard, U.S.A.
A turbine type pump, directly driven from semi-ball joint splined socket (by motor NOT SUPPLIED) clockwise rotation. Dim.: overall 11½ x 7½ x 13in.
ASK FOR X/H407 — 39/6 each — CARRIAGE PAID

PUMP DESSICATOR, Adm. Patt. No. 12128
For Telescopes and Binoculars.
ASK FOR S/H358 — £3.10.0 each — CARRIAGE PAID

ROTARY CONVERTER TYPE 195
ASK FOR X/H914 — £5.19.6 each — CARRIAGE PAID

AMPLIFIER A1368
For Battery operation. Less valves
ASK FOR X/E898 — 4/6 each — POST 6d. EXTRA

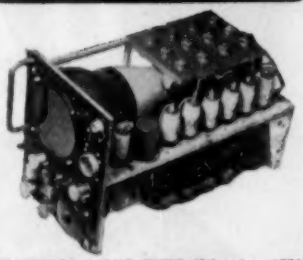
GUN SIGHT PROJECTOR UNIT TYPE 30
ASK FOR X/H882 — 19/11 each — POST PAID

AMPLIFIER A1271. Ref. 10U/549
ASK FOR X/H532 — 4/11 each — POST 1/-
Circuit 1/3.

JEFFERSON TRAVIS UF2
Transceiver Chassis (U.S.A. made).
Less valves, stripped by the M.O.S.
ASK FOR X/H518 — 17/6 each — CARRIAGE PAID
Circuit 2/6.

WALNUT-FINISH WOOD RADIO CABINET
Dim.: Internal 8½ x 15½ x 7½in. approx. External 9½ x 17 x 8in. approx.
ASK FOR X/H394 — 12/6 each — POST PAID
Or Cabinet as above with 3 waveband glass dials, expanded metal L.S. grille, 3 knobs 1½in. dia. fluted type.
ASK FOR X/H945 — 17/6 each — POST PAID

INEXPENSIVE T.V.



INDICATOR UNIT TYPE 62A with EF50's
Used, good condition.
ASK FOR X/H868 — 79/6 each — CARRIAGE PAID

INDICATOR UNIT TYPE 62
In original wood case.
ASK FOR X/H526 — £3.19.6 each — CARRIAGE PAID

INDICATOR UNIT TYPE 62
Used, good condition.
ASK FOR X/E774 — 49/6 each — CARRIAGE PAID

INDICATOR UNIT TYPE 6
In original wood case.
ASK FOR X/H524 — 79/6 each — CARRIAGE PAID

INDICATOR UNIT TYPE 6H
In original wood case.
ASK FOR X/E777 — 89/6 — CARRIAGE PAID

INDICATOR UNIT TYPE 305
BRAND NEW. Ref. L0Q8/6504
Contains VCR524A-VCR525. 7 EF50's etc.
ASK FOR X/H943 — £3.19.6 each — CARRIAGE PAID

5CP1 CATHODE RAY TUBE
In original carton.
6in. electrostatic type, heaters 6.3 v., 0.6 a.
ASK FOR X/H529 — 19/6 each — POST PAID

ION TRAP MAGNET ASSEMBLY
Mfg. Surplus.
Type IT/6 by Elac for 35 mm. tube neck.
ASK FOR X/H919 — 2/6 each — POST 3d EXTRA

POWER UNIT TYPE 285
Ready made for T.V.
A.C. mains. Input 230 v. 50 c.p.s. Outputs E.H.T. 2 kV. 5 mA., H.T. 350 v. 150 mA, L.T. 6.3 v. 10 a. and 6.3 v. 5 a. Fully smoothed and rectified with valves VU120, 5U4G, VR91 (EF50) plus cond., resistors, etc.
ASK FOR X/H947 — £4.19.6 each — CARRIAGE PAID

IF/AF AMPLIFIER UNIT R1355
In transit case.
With valves, I.F. frequency 7.5 Mc/s. Dim.: 18 x 8½ x 7½in. Used, good condition.
ASK FOR X/E7708 — 32/6 each — CARRIAGE PAID

R.F. UNIT TYPE 24
In original carton.
Switched tuning 20-30 Mc/s with valves, etc.
ASK FOR X/H580 — 22/6 each — POST PAID

R.F. UNIT TYPE 25
In original carton.
Switched tuning 40-50 Mc/s with valves, etc.
ASK FOR X/H847 — 22/6 each — POST PAID

R.F. UNIT TYPE 27
With broken dial.
Variable tuning 65-85 Mc/s., with valves, etc., used, good condition.
ASK FOR X/E771 — 39/6 each — POST PAID

Order direct from :—
CLYDESDALE SUPPLY CO. LTD. 2, BRIDGE STREET, GLASGOW, C.5
Phone : South 2706/9 Branches in Scotland, England and Northern Ireland

GARLAND

The "Unitelex Prima" Tape Recorder

57 GNS. OR ON HIRE PURCHASE

(£19/19/- Deposit. Balance by 6 monthly instalments of £7/3/- or 12 monthly instalments of £3/13/2.)

TAPE DECK: Truvox Mk. III. 3-motor Twin Track Two Speed (3¾in. per second and 7½in. per second). **AMPLIFIER:** Unitelex PR3A. Valves EF40, 12AX7, EL41, EL41, EM34. Separate power pack with full-wave metal rectifier system for robustness and instantaneous brake operation. **CONTROLS:** Bass control (boost) operative on both record and playback; treble control (boost and cut) operative on playback; volume control. **INPUTS:** Low Gain 20mv. across 1 megohm, used for recording from Radio, Television and Gramophone. High Gain 100μV across 2 megohm, used for recording from microphone. **FREQUENCY RESPONSE:** 50 Cycles—10 Kc/s ± 3 db on recording. 30 Cycles—14 Kc/s ± 1 db on direct playback. **OUTPUT:** 4 watts. **L/SPEAKER:** High—Flux 10in. elliptical speaker—provision for feeding up to 2 extension speakers; switch for MUTING internal speaker if desired. **RECORD LEVEL INDICATION:** Magic eye. Direct Playback available for playing records from Gramophone unit or as direct microphone amplifier. A.C. Mains only, 200/250, 50 cycles. Supplied complete with microphone and tape. Weight 35 lbs. Dimensions: Height 18½in., Width 17½in., Maximum Depth 10in. Send 2½d. stamp for illustrated brochure.

SELECTION OF BOOKS

Practical Radio for Beginners	3/3
Wireless World Guide to Broadcasting Stations	2/3
Television Servicing Manual	4/10
High Fidelity Radio	3/9
The Midget Radio Instructors Manual	3/9
Radio and T.V. Pocket Book	2/9
Tape and Wire Recording	2/9
Mullard Valve and Service Reference Manual	5/6
Mullard Amateurs Guide to Valve Selection	1/9
Osram Valve Manual, Part I	5/6
Brimar Radio Valve and Teletube Manual	5/6
Wireless World Radio Valve Data, 3rd edition	3/9
Radio Valve Guide. By W. J. May	5/6
The Williamson Amplifier Manual, latest edition	3/9
Wireless World High Quality Amplifier Manual	2/9
T.V. Fault Finding	5/4
Television Faults	5/4
Television Explained (Miller)	5/4
Viewmaster Envelope (state transmitter for which required)	7/10
Tele-King Envelope	6/4
The Oscilloscope Book	5/4
Magnetic Recording (Quartermaine)	4/10

(Prices are post paid in all cases.)

BRENETTE MICROPHONES. Large sales of these popular microphones have enabled us to make substantial reductions in the prices. The following range is available: **Type 9ND:** Multi-directional ball-type, in black and chrome, £2/2/-, post 2/-. **Type 7D:** Directional type, for instrumental or vocal use; black and chrome, £3/15/-, post 2/6. **Type IIA:** A wide-frequency-response microphone, in brown cast case with chrome grille, £8/5/-, post 2/6. **Type 13U:** A highly sensitive studio microphone with outstanding frequency characteristics. Flexible mounting enables it to be used directionally or not as required. Black and chrome finish, £6/6/-, post 3/6.

EXAMPLES OF OUR "EASY PAYMENTS" TERMS

ARTICLE	Cash Price	Deposit	6 monthly payments	12 monthly payments
T.V. Enlargers 9in.	£2 10 0	16 8	6 2	—
T.V. Enlargers. 12in.	£3 10 0	£1 3 4	8 8	—
De Luxe T.V. Enlargers. 12in	£3 15 0	£1 5 0	9 2	—
Amplion Testmeter. 10 ranges A.C.-D.C.	£5 0 0	£1 13 4	12 3	—
Bremi Microphone 7D	£3 15 0	£1 5 0	9 2	—
Bremi Microphones IIA	£5 5 0	£1 15 0	12 10	—
Three 1,200ft. reels Scotch Boy Tape	£5 5 0	£1 15 0	12 10	—
Collaro AC514	£6 5 11	£2 2 0	15 1	7 10
Bremi Microphone 13U	£6 6 0	£2 2 0	15 1	7 10
Goodmans Axiom 101. 8in. L/Spkr.	£6 12 1	£2 4 1	15 9	8 1
Garland Amplifier ACIIA	£6 12 6	£2 4 2	15 9	8 1
Collaro AC47	£6 13 4	£2 4 6	15 11	8 2
Wharfedale Golden CBS. 10in. Speaker	£8 6 7	£2 15 7	19 11	10 2
Goodmans Audiom 60 Speaker	£8 12 6	£2 17 6	£1 0 8	10 7
B.S.R. 3-speed single player. GU4	£9 5 0	£3 1 8	£1 2 2	11 4
Connoisseur Pick Up, 2 heads	£9 5 6	£3 1 10	£1 2 2	11 4
Leak Pre-amplifier	£9 9 0	£3 3 0	£1 2 7	11 7
Wharfedale W12/cs. 12in.	£9 15 0	£3 5 0	£1 3 4	11 11
Goodmans Axiom 150, Mk. II	£10 5 6	£3 8 6	£1 4 7	12 7
Leak "Varislope" Pre-amplifier	£12 12 0	£4 4 0	£1 10 2	15 6
Garrard 3-speed Auto-changer. R.C.75A	£15 8 1	£5 2 8	£1 16 10	18 10
Garland Amplifier AC IV	£15 15 0	£5 5 0	£1 17 8	19 3
B.S.R. "Monarch" 3-speed Auto-change	£16 10 2	£5 10 1	£1 19 6	£1 0 3
Garrard 3-speed Auto-change. R.C.80	£17 1 3	£5 13 9	£2 0 10	£1 0 11
Lane Tape Desk, Mk. IV	£17 10 0	£5 16 8	£2 1 10	£1 1 5
"Unitelex" Record/Playback Amplifier PR3A	£20 0 0	£6 13 4	£2 7 10	£1 4 6
Connoisseur 3-speed unit	£21 17 3	£7 5 9	£2 12 3	£1 6 9
Truvox Tape Deck, Mk. III	£23 2 0	£7 14 8	£2 15 3	£1 8 3
Leak "Point One" Amplifier	£28 7 0	£9 9 0	£3 7 9	£1 14 8
G.U.A.D. Amplifier with pre-amplifier	£35 0 0	£11 13 4	£4 3 0	£2 2 9
Unitelex "Prima" Tape Recorder. (Described above)	£59 17 0	£19 19 0	£7 3 0	£3 13 2

BROS, Ltd.

GOODMANS OUTPUT TRANSFORMERS. 10 watts push-pull to match into 10,000 ohm., with two 3.75 ohm. secondaries for 3 or 15 ohm. speaker. Price **14/9.**

MAINS TRANSFORMERS. All at **19/6** each.
MT1. 250-0-250 v., 80 mA., 0-4.5 v., 2 A., 0-4-6.3v. 3 A.
MT2. 350-0-350 v., 80 mA., 0-4-5 v., 2 A., 0-4-6.3 v. 3 A.
MT3. 0-30 v., tapped to give 3 v., 4 v., 5 v., 6 v., 8 v., 9 v., 10 v., 12 v., 15 v., 18 v., 20 v., 24 v., 30 v., all at 2 amp.
MT4. 4 v. 4 amp. ; 10 v. 4 amp. ; 20 v. 3 amp., for battery chargers.
MT5. Auto: 0-10-120-200-230-250 v., at 100 watt.

JACKSON BROS. SPIN WHEEL DIAL ASSEMBLIES. 3 wave band, **27/6**, plus 1/6 post and packing. **SQUARE PLANE**—2 wave band, **12/9**, plus 1/6 post and packing.

OSMOR GLASS DIAL ASSEMBLIES. Long, Medium and Short, or Medium Short, Short, **24/6**, plus 1/6 post and packing.

JUNEERO ENGRAVING TOOL. Engraves on Metals, Plastics, Woods, etc., For 200-240 v. A.C. mains, **10/-** each.

ELAC 5in. LOUDSPEAKER, 17/6, plus 1/- post and packing.

TRIMMERS. 50 pF 50 + 50 pF, 100 + 100 pF, 100 + 500 pF, ceramic mica, **9d.** each ; 250 pF, 1,000 pF, **9d.** each ; 50 pF, 75 pF, airspaced preset, 1/3 each ; 75 pF, air-spaced, 2in. spindle, 2/- each. 33⅓ per cent. discount in dozen lots.

RECTANGULAR KNOBS. Size 1¼in. x ¾in., with gold indicating spot ; to fit standard ¼in. spindles. Price 5/- per doz., **37/6** per 100.

TYANA SOLDER GUNS. Weight 30 oz., for 220-250 v. A.C. mains only ; consumption 100 watts. The low voltage bit can be easily bent to reach into corners and is insulated from the earthed case. Price **3 guineas.**

CERAMIC SWITCHES. Single pole, eight-way, **3/6** each.

T.R.F. COILS. Medium and long wave, aerial and H.F., **6/-** per pair ; with reaction winding, **6/9** per pair.

BRIMISTORS. Non-linear resistors to protect valves from current surges : CZ1, 0.3A, **3/6** ; CZ2, 0.3A, **2/6** ; CZ3, 0.2A, **1/6** ; CZ4, -1.25 A, 5/- ; CZ6, 0.45A, **3/6.**

MOULDED BROWN BAKELITE CABINETS. Suitable for fitting Decca 3-speed gram. motor, amplifier or loudspeaker. Outside dimensions (closed) 15½in. x 10in. x 5¼in. ; thickness of wall, 1/6th in. Price **22/6,** to callers only.

"HERALD" TAPE RECORDER. 8in. Speaker, 2 inputs with mixing controls, Lane Tape Table, Single tape speed twin track recording. Fast rewind and forward speeds. **48 Gns.** or on H.P. Send 2½d. stamp for brochure.

AMPLION TESTMETER. 10 Ranges, A.C. and D.C. up to 500 V. A.C. and D.C. Resistance up to 200,000 ohms, 1,800 ohms per volt A.C. and D.C. **£5** or terms.

AERIAL RODS. These popular rods of tough steel, copper-plated are 12in. long and fit into each other to make any length. **3/6** per dozen, **£1** for 100 post paid.

H.F. PENTODES. Type 6SH7 6.3 V. 0.3 a. heater, int. octal base, high slope, **5/6** each, **27/-** per half dozen, **£20** for 100.

ELECTROLYTICS. 60 plus 120 MFD. 350 v., 450 mA. ripple, **7/3** each. Other values as previous advertisements.

PICK-UPS.
DECCA XMS. 2 Leads with latest type "H" LP Lead, having improved frequency response, **£6/9/3.**

ACOS GP30 turnover type. **£3/6/1.**
ROTHEMEL 78 R.P.H. Xtal, **£1/8/2.**

ACOS MICROPHONES. MIC 33-1 omni-directional for hand or desk including acoustic filter giving flat response from 30-7,000 cycles. **£2/10/-.** MIC 35-1 robust hand microphone particularly useful in noisy locations or when acoustic feedback is troublesome. **£1/5/-.**

GARLAND AC11 AMPLIFIER. This amplifier provides a maximum output of 3.5 watts. Standard valves (6SH7, 6SH7, 6V6G, 5Z4G) are used throughout and H.T. and L.T. supplies are from mains transformer thus ensuring isolated chassis. A volume and a treble cut control are incorporated. By careful circuitry and the use of negative feedback extremely good quality of reproduction is ensured ; the following are actual measured characteristics on a standard production amplifier. Distortion .8% for 2 w. output at 1 K/c ; Frequency response within 1 db from 60 c/s to 20 K/cs. Although the amplifier as normally supplied is intended for use with gramophone pickups of the Acos GP20 type, it can if required be supplied with adequate gain to enable its use with crystal cell microphones. Price **£6/12/6,** plus 5/- carriage etc. Weight 10lbs.

TELEVISION MAGNIFYING LENSES, 6in. clear, **19/6** ; 9in. clear or filter, **50/-** ; 12in. clear or filter, **70/-.** Please state which and add 5/- for carriage and packing.

PAXOLIN PANELS. 3¼in. x 1¼in. x 3/32in., 1/- per doz 5/- per 100. 2¼in. x 2in. x 1/16in., 1/3 per doz., 6/- per 100. Many thousands available.

MAGNETIC TAPE. Now available, the new Scotch Boy High Coercivity Tape MC2-111, with higher output and signal-to-noise ratio. Price **35/-** per 1,200ft. reel. Still available : Scotch Boy MCI-111 : 1,200ft., **35/-** ; 600ft., **21/-** ; 300ft., **12/3.** Spare 7in. spools, **4/3.** Ferrovoice, the new kraft-based medium coercivity tape : 1,200ft., **22/6.** Spare 7in. spools, **4/6.** Magnetophon Tape : **£2** per 1,200ft. reel.

DECALS. 500 ¼in. high black or white transfer letters and words for marking electronic equipment. Price **4/9** per book. The new Decals book for the amateur now available. 29 words per page, 4 pages radio and audio, 4 pages T/V and Scope, 2 pages misc. inc. Tx. and Tape Recording, **3/6** per book, post 3d. When ordering please state colour required.

CLEARANCE OF SPECIAL PURPOSE EX-GOVT. VALVES AND AMERICAN SURPLUS RECEIVING VALVES.

CV1141, 4 v. Thyratron	5/-
6B4G, 6.3 v. O/P Triode	5/-
12SG7, 12 v. Vari-mu	5/-
7Q7, 6.3 v. Freq. Changer	7/6
6K6GT, 6.3 v. O/P Pentode	7/6
6H6 (GT) 6.3 v. D/D	3/6
VR54, Ditto	2/6
VR56, 6.3 v. H.F. Pen.	5/-
CV73, 4 v. Pulse Amplifier	5/-
VR150, Regulator	10/6
VR105, Ditto	8/6
CV181, 6.3 v. Double Triode	6/6
6U5G, Magic Eye	7/6
6J5GT, 6.3 v. Triode	7/6
807, Beam Tetrode	9/6
6SL7, 6.3 v. D/Triode	8/6
6SN7, Ditto	8/6
6K7G, 6.3 v. Vari-mu	8/6
6V6G, 6.3 v. O/P Tetrode	8/6
6SS7, 6.3 v. Vari-mu	5/-
1625, 12 v, 807	4/9
SU4G, 5 v. D/H Rectifier	9/6
SCP1, E/S C.R.T. (strictly callers only)	15/-

WHANDA WIRE AND CABLE STRIPPERS to take all size flexes and cable up to ¼in. diam. with 3 alternative heads and triple screw adjustment. These are brand new and boxed, and the original price was 15/- each. Our price **5/-** each, post paid.

THE LATEST LANE TAPE TABLE. Incorporating three heavy duty motors ; fast rewind and wind-on without tape handling ; automatic braking ; high impedance half-track heads ; hub locking device. Tape speed 7½in. per second. Price **£17/10/-.** Carriage 10/-.

COLLARO 3 SPEED RECORD PLAYER DESKS with 2 plug-in ortho-dynamic heads. **£6/6/6.** Limited stock only.

TAPE RECORDER OSCILLATOR COILS. 6.3 mH, 45 kc/s, for high impedance heads only. Price **6/9** each.

GOODMANS H6 OUTPUT TRANSFORMERS. Rated up to 30 watts push-pull ; ten-section wound on silicon steel laminations with primary inductance of 100 H and negligible leakage inductance and capacitance. Primary 10,000 ohms C.T. Secondary 3.75 plus 3.75 ohms. Price **£3/3/-,** plus 2/6 p. and p.

TAMSA TYPE 100 TAPE RECORDING HEADS. As used by the leading commercial tape recorder manufacturers. Housed in chromium plated brass case on adjustable mounting. Record/playback heads have ½-thou. gaps and erase heads have 2.5 thou. gaps. These heads are of high impedance. Price **45/-** each

VARLEY MAINS TRANSFORMERS. Primary 10-0-200-220-240 volts. Secondary 300-0-300 volts at 150 mA., 5 volts at 3 amps., 6.3 volts at 4 amps., 6.3 volts at 1 amp. Open type construction. Price **45/-,** post 2/6.

WINDSOR SAPPHIRE NEEDLES. Available in the following three patterns : trailer type for magnetic or heavyweight pick-up ; straight type for crystal pick-up ; midget type for lightweight or high fidelity pick-up. Price **2/6** each.

GARLAND TAPE RECORDER OSCILLATOR UNITS. With valve, for use with high impedance heads only. Price **35/-**

ALL GOODS NEW AND UNUSED (except where otherwise stated).

PLEASE ADD POST OR CARRIAGE ON ALL ITEMS. KINDLY PRINT NAME AND ADDRESS. POST ORDERS TO OUR DEPTFORD ADDRESS. EARLY CLOSING THURSDAY, OPEN ALL DAY SATURDAY.

SHOP HOURS: *Mon: Tues: Wed: and Sat:* 9 a.m.—6 p.m. *Thurs:* 9 a.m.—1 p.m. *Fri:* 9 a.m.—7 p.m.

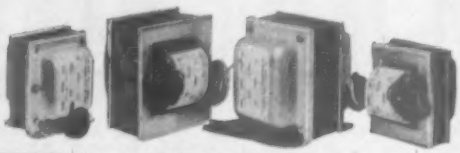
GARLAND BROS. LTD.

CHESHAM HOUSE, DEPTFORD BROADWAY, S.E.8. TEL : TIDEWAY 4412/3
5 OBELISK PARADE, LEWISHAM, S.E.13. TEL : LEE GREEN 4038

R.S.C. MAINS AND OUTPUT TRANSFORMERS

Fully Guaranteed, Interleaved and Impregnated

FILAMENT TRANSFORMERS
Primaries 200-250 v. 50 c/cs.
6.3 v. 1.5 a. 5/9
6.3 v. 2 a. 7/6
6.3 v. 3 a. 9/6
0-4-6.3 v. 2 a. 7/9
12 v. 1 a. 7/11
6.3 v. 6 a. 17/6
0-2-4-5-6.3 v. 4 a. 16/9
12 v. 2 a. or 24 v. 1.5 a. 17/6



SMOOTHING CHOKES
250 mA. 7-10 H. 200 ohms Shrouded 16/9
250 mA., 3 H. 50 ohms 11/9
100 mA., 15 H. 350 ohms 7/6
80 mA., 10 H. 350 ohms 5/6
60 mA., 10 H. 400 ohms 4/11
50 mA., 40 H. 1,000 ohms Potted ... 10/9

ELIMINATOR TRANSFORMERS
Primaries 200-250 v. 50 c/s.
120 v. 40 mA. 7/11
90 v. 10 mA., 8-0-8 v. 250 mA. 9/11

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s. Primaries: 0-9-15 v. 1.5 a., **14/9**; 0-9-15 v. 3 a., **16/9**; 0-9-15 v. 6 a., **22/9**; 0-4-9-15-24 v. 3 a., **22/9**; 0-9-15-30 v. 3 a., **23/9**. 0-22-23-24 v. 5 a., **19/6**.

TOP SHROUDED DROP THROUGH TYPE
Primaries 200-230-250 v. 50 c/s.
250-0-250 v. 70 mA., 6.3 v. 2.5 a. 12/11
260-0-260 v. 70 mA., 6.3 v. 3 a., 5 v. 2 a.... 14/11
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.... 16/9
350-0-350 v. 80 mA., 6.3 v. 3 a., 4 v. 2.5 a.... 14/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a... 23/9
300-0-300 v. 100 mA., 6.3 v.-4 v., 4 a., c.t., 0-4-5 v. 3 a. 23/9
350-0-350 v. 100 mA., 6.3 v.-4 v., 4 a., c.t. 0-4-5 v. 3 a. 23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.... 29/11
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. 29/11

E.H.T. TRANSFORMERS. 2,500 v. 5 mA., 2-0-2 v., 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 or ACR2X 35/-
5,000 v. 5 mA. 2 v. 2 a. 39/6

Primaries 200-230-250 v. 50 c/s.
FULLY SHROUDED UPRIGHT MOUNTING
250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a., Midget type 2½-3-3in. 16/9
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.... 18/9
300-0-300 v. 60 mA., 12 v. 1.5 a., c.t. 18/11
250-0-250 v. 100 mA., 6.3 v.-4 v. 4 a. c.t., 0-4-5 v. 3 a. 25/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v., 3 a., for K1355 conversion 29/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a. c.t., 0-4-5 v. 3 a. 25/9
350-0-350 v. 100 mA., 6.3 v.-4 v. 4 a. c.t., 0-4-5 v. 3 a. 25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a. 33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. 33/9
350-0-350 v. 160 mA., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a. 45/9
350-0-350 v. 250 mA., 6.3 v. 6 a., 4 v. 8 a., 0-2-6 v. 2 a., 4 v. 3 a., for Electronic Eng. Televisor 67/6
425-0-425 v. 200 mA., 6.3 v.-4 v. 4 a. c.t., 6.3-4 v. 4 a., c.t., 0-4-5 v. 3 a., suitable Williamson Amplifier, etc. 49/9
425-0-425 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v 3 a. 65/6

SMOOTHING CHOKES
250 mA. 7-10 H. 200 ohms Shrouded 16/9
250 mA., 3 H. 50 ohms 11/9
100 mA., 15 H. 350 ohms 7/6
80 mA., 10 H. 350 ohms 5/6
60 mA., 10 H. 400 ohms 4/11
50 mA., 40 H. 1,000 ohms Potted ... 10/9

OUTPUT TRANSFORMERS
Midget Battery Pentode 66 : 1 for 3S4, etc. 3/6
Small Pentode, 5,000Ω to 3Ω 3/9
Small Pentode, 8,000Ω to 3Ω 3/9
Standard Pentode, 5,000Ω to 3Ω 4/9
Standard Pentode, 8,000Ω to 3Ω 4/9
Standard Pentode, 10,000 ohms to 3 ohms... 4/9
Multi-ratio 40 mA. 30 : 1, 45 : 1, 60 : 1, 90 : 1, Class B Push Pull 5/6
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω... 15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω 19/9
Push-Pull 15-18 Watts to match 6L6, etc., to 3Ω or 15Ω Speaker 22/9
Push-Pull 20 Watts high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω 47/9
Williamson type, exact to author's specification 35/-

MICROPHONE TRANSFORMERS
100 : 1 ..... 5/9

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000pfd. (.001μF), .002 mfd. (2,000 pfd.). All at **8d.** each; **3/9** dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., **6/9** doz. 6.5 v. 0.15 a., **6/9** doz.

VOLUME CONTROLS with long spindles, all values less switch, **2/9**; with S.P. switch, **3/9**.

WIRE WOUND POTS: 20 ohms, 30 ohms, 1,000 ohms, 5K, 50K (medium length spindles), **2/9.** 220 ohms, 2K, 10K, 20K, 50K Preset type, **1/9** ea.

AMMETERS. Moving coil. G.E.C. 0—5 amps., 2in. scale, **12/6.**

ELECTROLYTICS (Current production. NOT ex-Govt.).

Tubular Types		Can Types	
8μF 450 v.	1/11	16μF 450 v.	2/9
8μF 500 v.	2/9	24μF 350 v.	2/11
16μF 350 v.	2/3	32μF 350 v.	2/11
16μF 450 v.	2/9	32 mfd. 450 v.	4/9
16μF 500 v.	3/9	40μF 450 v.	4/9
24μF 350 v.	3/3	64mfd. 450 v.	4/9
32μF 350 v.	3/9	8-8μF 350 v.	3/9
32 mfd. 500 v.	5/9	8-8μF 450 v.	3/11
8-16μF 500 v.	4/11	8-16μF 450 v.	4/6
25μF 25 v.	1/3	16-16μF 450 v.	4/11
50μF 12 v.	1/2	16-16 mfd. 500 v.	5/9
50μF 50 v.	2/3	16-32μF 350 v.	4/9
Can Types		32-32μF 350 v.	4/9
8 mfd. 450 v.	2/3	32-32μF 450 v.	5/11
8 mfd. 500 v.	2/11	64-120 mfd. 350 v.	7/6
16 mfd. 350 v.	1/11		

MISCELLANEOUS EX-GOVT. ITEMS
Slydelock Fuses, 15 amp., **1/2.** Bulgin panel mounting Fuseholders (ex-equip.), **11d.** Bulgin octal type moulded Bakelite, 5-pin or 7-pin Plugs and Sockets, **1/11** pr. Earphones (Single), low resistance, **1/3.**

EX-GOVT. ACCUMULATORS with non-spill vents. Unused and guaranteed. 2 v. 16 A.H. Size 7½—4—2in., **5/9.** Or set of 3 wired for 6 volts in wood carrying case 9—7—5in., **14/9,** plus 2/6 Carr.

P.M. SPEAKERS. All 2-3 ohms. 5in., Goodmans, **14/9,** 6½in. Elac., **14/11,** 6½in. Plessey with Pentode Trans., **14/11,** 8in. Plessey, **15/9,** 8in. R.A. Heavy duty, **18/9,** 10in. Goodmans, **31/-,** 10in. Plessey, **18/6,** 10in. Rola, with Trans., **29/6,** 12in. Truvox, **49/9.**

M.E. SPEAKERS. All 2-3 ohms, 6½in. Rola field 700 ohms, **11/9,** 10in. R.A. field 600 ohms. **23/6.** 10in. R.A. field 1,500 ohms, **23/6.** 10in, R.A. Field 1,000 ohms, **23/9.**

BAKELITE AND WALNUT VENEERED CABINETS

Size approximately 12in. × 6½in. × 5in. Bakelite type available in Brown or Cream. Price of Cabinets, **17/6** ea., carr. 2/6.
Suitable fully punched T.R.F. 3-valve and rectified chassis 3/9
Suitable fully punched superhet chassis (4 valves and rect.) 4/9
Dial Scales, 2 colour, 2 waveband, station named, glass 1/6
Dial Scales, 3 colour, 3 waveband, station named, glass 1/9
Suitable coloured Metal Backplates 1/3
Pointers, Double ended ..... 4d.
T.R.F. Coils, 2 waveband with circuit 6/9
Drum Drives, complete 2/6
Constructional Envelope of an All Mains 2 wave T.R.F. Receiver (3 valves and rectifier) which can be built in any of above cabinets for approximately £4/15/- 2/6

SELENIUM RECTIFIERS

L.T. Types		H.T. Types H.W.	
2/6 v. 1 a.h.w.	1/11	70 v. 20 mA.	2/11
F.W. Bridge Types		90 v. 20 mA.	3/6
6/12 v. 1 a. ...	5/9	120 v. 40 mA. ...	3/11
6/12 v. 2 a. ...	9/9	250 v. 50 mA. ...	5/9
6/12 v. 4 a. ...	17/9	350 v. 50 mA. ...	7/9
6/12 v. 6 a. ...	22/9	250/350 v. 80 mA.	8/9

EX-GOVT. E.H.T. SMOOTHING CONDENSERS
.02 mfd. 5,000 v. Bakelite Tubulars..... 1/6
.02 mfd. 8 000 v. Cans 1/11
.1 mfd. 2,500 v. Cans 3/6
.1 mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated) 9/6

SPECIAL PURPOSE EX-GOVT VALVES (GUARANTEED)
VR91, **5/9,** SP61 (VR65) **2/9,** VR55 **3/11,** AC6Pen **5/3,** 807 **6/11,** 7193 **1/3,** 6J6 **10/6,** 954 **1/11,** 6SH7-Met **6/11,** 12SC7GT **6/11,** RK34 **2/6,** VU120A **2/6,** SP41 (VR65A) **1/11.**

EX-GOVT. WIRE WOUND POTS.
(Ex-equipt., insulated spindles).
Bakelite type, spindles approx. 1in. 2K, 2.5K. 15K, 50K, 100K **2/3** ea.

EX-GOVT. AUTO TRANSFORMERS 50 c/cs
15-10-5-0-215-235 v. 200 watts ... 25/9
Double wound 10-0-200-220-240 v. input, 10-0-270-290-310 v. output 200 watts 27/9

EX-GOVT. MAINS TRANSFORMERS.
All 230 v. 50 c/cs input. 48 v. 1 a. output 9/6
Outputs 250-0-250 v. 40 mA., 6.3 v. 2 a., 5 v. 2 a. 19/6
350-0-350 v. 150 mA. 5 v. 3 a. 17/6

VALVE SCREENING CANS. International Octal 3 piece, **10/6** doz., **1/3** each.

EX-GOVT. SMOOTHING CHOKES
250 mA., 10 H. 50 ohms. 14/9
250 mA., 40 H. 200 ohms. Trop. type 17/6
250 mA. 20 H. 250 ohms. Tropicalised ... 13/9
250 mA. 10 H. 100 ohms 12/9
250 mA. 5 H. 100 ohms. Potted type 9/6
250 mA. 3 H. 50 ohms Potted..... 7/6
150 mA. 10 H. 50 ohms 10/11
100 mA. 10 H. 100 ohms 8/11
100 mA. 15 H. 450 ohms. Tropicalised ... 5/9
100 mA. 5 H. 100 ohms. Tropicalised 4/6
50 mA. 50 H. 1,250 ohms. Potted type ... 8/11
40 mA. 5-10 a. 2/9
60 mA. 5-10 H. 3/9

EX-GOVT. T.V. TYPE TRANSFORMERS. All 230 v. 50 c/s input.
6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a., 5 v. 3 a., 4 v. 3 a. 22/6
278-0-278 v. 80 mA. 7/9
350-0-350 v. 160 mA., 6.3 v. 6 a., 5 v. 3 a.... 27/6
400 v. C.T. 150 mA., 4 v. 6 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a. 22/9

EX-GOVT. BLOCK PAPER CONDENSERS

4 mfd. 500 v.,	2/9	4 mfd. 1 000 v.	3/11
4 mfd. 750 v.,	3/3	4 mfd. 2,000 v.,	5/9
10 mfd. 500 v.,	6/9	10 mfd. 1,500 v.	7/9

EX-GOVT. CATHODE RAY TUBES
VCR517 (guaranteed full picture) (carr. 5/-) **29/6** ea.
ACR2X (guaranteed full picture) (carr. 5/-) **12/6** ea.

SPECIAL OFFERS. Germanium Crystal Diodes **1/11.** Midget Mains Transformers (size approx. 2½ × 3 × 2½in.) Screened Primary 220/240 v. 50 c/s. Output 250-0-250 v. 60 mA., 6.3 v. 2 a. Only **11/9.**

CO-AXIAL CABLE. 75 ohms ½in. **9d.** yard. Twin screened feeder, **9d.** yard.

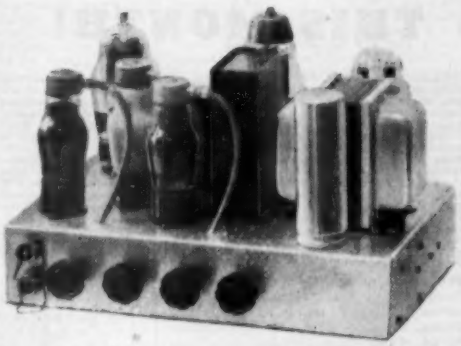
EX-GOVT. CATHODE ISOLATING FILAMENT TRANSFORMERS. 6.3 v. to 6.3 v. c.t., **3/9** ea

R.S.C. 25 WATT "PUSH PULL" AMPLIFIER

Now firmly established and proving extremely popular, our All Quality Amplifier we consider to be the best value in amplifiers offered to-day. The volume of its high fidelity reproduction is completely controllable, from the sound of a quiet intimate conversation to the full glorious volume of a great orchestra. Its sensitivity is so high that in areas of fair signal strength it can be operated straight from a crystal receiver. Entirely suitable for standard or long playing records in small homes or in large auditoriums. For electronic organ or guitar or for garden parties or dance bands.

The kit is complete to the last detail, and includes easy to follow point-to-point wiring diagrams.

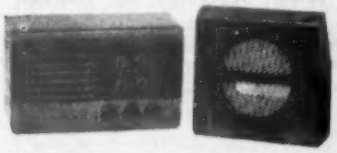
Twin volume controls with twin input sockets allow SIMULTANEOUS INPUTS for BOTH MICROPHONE and GRAM, or TAPE and RADIO. SEPARATE BASS and TREBLE CONTROLS giving both LIFT and CUT. FOUR NEGATIVE FEEDBACK LOOPS with 15 db in the main loop from output transformer to voltage amplifier. Frequency response ± 3 db. 50-20,000 c.p.s. Hum and distortion LESS THAN 0.5 per cent. measured at 10 watts. This is comparable with some of the highest priced amplifiers. Six B.V.A. valves, Marconi/Osram KT series output valves. A.C. only, 200-230-250 v. 50 c/cs. input. 420 v. H.T. LINE. Paper reservoir condenser. Compact chassis. Matched components. OVERALL SIZE 14-10-9in. approx. Output impedances for 3 and 15 ohms speakers.



Available in kit form at the amazingly low price of **9 gns.** Plus carriage 5/-

Or ready for use 50/- extra.

COLLARO SINGLE SPEED RECORD PLAYERS Type AC514, with Crystal Pick-up For A.C mains, input 200-250 v. Brand new, cartoned, only **£3/19/6**, plus 5/- carr.



R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 "Listen—Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Brown Bakelite cabinet is included. Mains input is 200-250 v 50 c/s. H.T. line 300 v CHASSIS IS NOT "ALIVE." Ideal also for use as "Baby Alarm" Sound amplification 4 watts. Price only **£5/19/6**. "Listen—Talk Back Unit" as illustration can be supplied at **27/6** each. Full descriptive leaflet **1/-**.

The Master Unit can be supplied assembled and tested for **27/6** extra.

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/s

FOR CHARGING RATE OF 6v. at 2 amps., **25/9.**
6v. or 12v. 2a., **31/9.**
6v. or 12v. 4a., **49/9.**

ABOVE KITS CONSIST OF BLACK CRACKLE STEEL CASE, MAINS TRANSFORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSEHOLDERS AND CIRCUIT Due to careful design the use of resistors for regulation of charge has been obviated. The mean charging rates are as indicated above, and complete safety is ensured by fusing of both input and output. Any type in working order **6/9** extra.

A PUSH PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £3/12/6, plus carr 2/6. For mains input 200-250 v. 50 c/s. Complete kit of parts including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick-up. Output is for 2-3 ohm speaker. (We can supply a very suitable 10in. unit by Goodmans at **31/-**). The amplifier can be supplied ready for use for **25/-** extra Full descriptive leaflet **7d.**

COLLARO 3-SPEED AUTOMATIC RECORD CHANGERS (brand new), type 3RC521, complete with 2 plug-in Crystal P.U. heads. Mains input 200-250 v. Limited number available at only **£9/15/-** plus carr. 5/-.

COLLARO GRAM MOTORS, TYPE AC37. Governor controlled at 78 r.p.m Mains input 110-200-230-250 v. Shaded pole type **35/-.**

COLLARO TAPE DESK MOTORS Shaded pole type. Clockwise or anti-clockwise Mains input 110-200-250 v., **31/6.**

PERSONAL SET BATTERY SUPERSEDER KIT.

Complete with case. Supplies 90 v. 10 mA. and 1.4 v. 250 mA. fully smoothed, from normal 200-250 v. 50 c/s. mains. For 4-valve superhet receivers Price with circuit. **35/9.** Or ready for use **42/6.** Size of unit 5-4-1½in

BATTERY SET CONVERTER KITS. All parts for converting any type of battery receiver to all mains A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v at up to 40 mA. and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only **45/9.** Supplied ready for use for **7/6** extra.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT. Consists of h.t. and l.t. transformer h.t. and l.t. rectifiers, smoothing electrolytic choke, and steel case. For mains input of 200-250 v. Output 120 v. 40 mA. and 2 v. ½ a. Price with circuit. **29/6.**

Or in working order, **37/6**

WILLIAMSON AMPLIFIER KIT. Complete set of parts (exact to author's specification) for construction of the original amplifier.

PRICE COMPLETE **14 gns.**

R.S.C. TONE CONTROL-PRE-AMP. UNIT. A complete set of parts for the construction of a very efficient but simple pre-amplifier and tone control unit. Suitable for use with any amplifier and pick-up. Fil. supply is self-contained. Overall size is 7½-5-5½in. approx. Full descriptive leaflet **9d.**

PRICE INCLUDING WIRING DIAGRAMS **37/6.**

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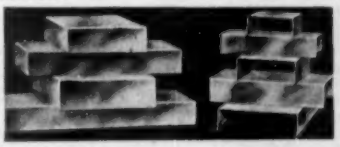

18 s.w.g. undrilled aluminium amplifier type (4 sided)

12in. × 9in. × 2½in.	6/11
14in. × 9in. × 2½in.	6/11
14in. × 10in. × 3 in.	7/11
16in. × 10in. × 3in	8/3

18 s.w.g. aluminium, receiver type. 6in. × 4½in. × 1½in. 1/11

7½in. × 4½in. × 2in.	2/9
10in. × 5½in. × 2in	3/3
11in. × 6in. × 2½in.	3/11

16 s.w.g. aluminium receiver type, 13—8—2½in. 5/3

16in. × 8in. × 2½in.	7/6
20in. × 8in. × 2½in.	9/11

16 s.w.g. aluminium, amplifier type 4 sided.

12in. × 8in. × 2½in	7/11
16in. × 8in. × 2½in.	10/11
20in. × 8in. × 2½in.	13/6
14in. × 10in. × 3in.	13/6

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SPECIAL THIS MONTH!

INFRA-RED RECEIVER, TYPE 5C/8001. This unit is an Infra-Red Detecting Device, as used by the R.A.F. for tail warning system. The unit consists of two parts, viz.: (1) an image converter tube of the type described in "Electronic Engineering" (Sept., 1948), is used in conjunction with a lens system. The Lenses, which are covered with an infra-red filter to admit infra-red radiation only, focus to object to be viewed on the photo cathode of the image converter. (2) A canister consisting of a number of high-voltage batteries connected to give a voltage of 4 kV. (These batteries are known as ZamBoni Piles, and are described in "Electronic Engineering," Oct., 1946.) A high voltage from this canister is applied to the tube and an image is formed on a fluorescent screen. This image is viewed by means of another lens, forming an eye-piece. These receivers have many uses in their original form, or their parts used in various work. The lenses are well mounted and the converter tube housed in an insulated case. This unit is ideal where high voltage with negligible current drain is required in a small space, and is useful for many other uses in laboratories, viz., electrostatic experiments with electroscopes of all types. Supplied in wooden transit case (size 20in. × 7½in. × 9in.). An absolute bargain at **£3/10/-.**

METERS. BRAND NEW AND BOXED.

0-30 mA., Moving Coil, 2½in. circular panel mounting ..... **8/6** each
0-150 mA. (scaled .15 A.), Moving Coil, 2½in. square panel mounting .. **7/6** ,,
0-200 mA., Moving Coil, 2½in. circular panel mounting ..... **8/6** ,,
0-300 mA., Moving Coil, 2½in. circular panel mounting ..... **8/6** ,,
0-6 amp., Thermo-Couple, 2½in. circular panel mounting ..... **6/6** ,,
0-15 v. A.C., Moving Iron, 2½in. circular panel mounting ..... **8/6** ,,
0-1 mA., Moving Coil, 2in. square panel mounting ..... **12/6** ,,
0-5 amp., Moving Coil, 2in. square panel mounting ..... **8/6** ,,
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Please add 1/- per Meter for postage.

HIGH-INDUCTANCE R.F. CHOKE. Suitable for use in **RINGING-CHOKE E.H.T. UNIT**, as described in "W.W.," Dec. 1953 (page 600). This choke used with 807 valve gives 4 kV. 350 μA. Brand new at **5/-**, post paid.

ROMAC VACUUM PUMP (Rotary Vane Type). Ideal where air pressure is required, viz., Paint Sprayers, etc. Brand new at **15/-** each, plus 2/- post.

LINE-OUTPUT TRANSFORMERS, with EY51 Rectifier. E.H.T. 7 to 9 kV. Price **22/6**, plus 2/6 post and packing.

TRANSLUCENT PROJECTION SCREENS (size 15½in. × 13in.). As used in projection television and epidiascopes. Price **7/6** each.

GRAM MOTORS. A.C. mains (200-250 v.), shaded pole inductance motor for rim-drive turntable. A few left at **5/6** each, plus 1/6 post.

COAXIAL CABLE. 75 to 80 Ω impedance. Brand new current stock, ½in. dia. Available in following lengths: 15 yds., 16 yds., 17 yds., 18 yds. and 19 yds. Price **6d.** per yd., plus 1/- postage.

HALF-WAVE TRANSFORMERS. Input 230 v. Output 280 v. 60 mA. 6.3 v. 1.5 amp. Price **7/6** each, plus 1/6 post and packing.

1,000 Ω WIRE-WOUND SLIDER CONTROLS. 2-3 watt, at **1/3** each, post paid.

COLVERN POTENTIOMETERS. 25 Ω Trimmer Type, **1/3** each; **12/-** doz.

VALVEHOLDERS. Ceramic B7G, with screening cans, at **1/3** each; **12/6** doz. Ceramic EF50 (B9G), at **9d.** each; **8/6** doz. **SPECIAL OFFER** of Govt. Surplus **BRAND NEW** Int. Octals (Amphenol), at **4/6** doz. Please add postage.

OCTAL PLUGS (with covers). Fits into Int. Octal Holder to make a useful Plug and Socket, **9d.** each; **8/6** doz.

CARBON MIKE INSERTS (Mark IV), at **1/6** each. **TRUVOX POWERMIKE INSERTS** at **2/6** each.

GERMANIUM XTAL DIODES, wire-ended, at **2/-** each; **18/-** doz.

POWER PACKS. A.C. mains input. Output 350 v. 80 mA. 6.3 v. 1.5 amp., 6.3 v. 1.5 amp. Complete with 5Z4 Rectifier, Transformer, Choke, etc. Size 5½in. × 6in. × 9in. deep. Price **25/-** each, plus 3/6 carr.

P.M. SPEAKERS. 10in. Rola (less transformer). Brand new at **22/6** each, plus 1/6 post.

AMPLIFIER UNIT, TYPE A1271. Containing EF36 Valve, 400 Ω Relay (4 makes, 2 breaks), 10,000 Ω Pot., Resistors, Condensers, etc., in black metal case, 8in. × 5in. × 5in. Brand new at **7/6** each, plus 1/6 post.

1128A RECEIVERS. 11 valve Superhet Receiver, covering 100 to 124 Mc/s, complete with all Valves, Tuning Meter, S.M. Drive, R.F. and I.F. gain Control, etc. Brand new with Circuit Diagram. A few left at **45/-** each, plus 5/- carr.

MIDGET 465 kc/s I.F. TRANSFORMERS. Dust core tuned. Size 1¼in. × 1in. dia. Price **6/9** per pair.

12-PIN PLUGS AND SOCKETS at **9d.** per pair; **8/6** doz. pairs.

POLYTHENE RODS, 5/16in. dia., 12in. long, at **6/-** doz.

MOTORS. Fractional H.P. 12v. A.C. or D.C. size 1¾" dia. × 9¼" long. Price **6/-** Plus 1/- Post.

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MARCONI OSCILLOSCOPE, LABORATORY CONSUL MODEL OR2/A 9in. C.R.T. 2ft. 3in. HIGH, 1ft. 4in. WIDE, 1ft. 4in. DEEP. IN PERFECT WORKING ORDER **£30.** Details on request.

Sound Reproducing Unit Type 11. Ref. JCU/41. Standard 19in. rack mounting. Containing Garrard Gram motor type 37 (variable speed), photo electric cell type CMB25 adjustable over 15 tracks of record disc, transformer 200/250 v. 50 cycle input, 10 v. at 5 amps., 20 v. at .5 amps. (used for operating photo electric cell), **£3/10/-.** Callers only.

Receivers Type R25. Suitable for conversion to Broadcast bands. Containing 2 off 460 kc/s. I.F. transformers, 6 octal valve blades, etc. Complete less valves. **7/6.** Postage 2/-.

Hydrometer Ball Indicating Type No. 1. 2B11065. New and boxed. 1/- each. Postage 6d.

Small 12 v. or 24 v. Motors. 3in. square with 1in. shaft. **5/-.** Postage 1/-. Large selection of continental radio transmitting and receiving valves.

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100 MICRO-AMP. METER. 2½in. barrel, 3½in. flange, panel mounting. Scaled 0-1500 in 15 clear divisions. These meters have just arrived and are **BRAND NEW** in original maker's cartons. Now in short supply, they are a real bargain at 42/6 each.

50 MICRO-AMP. METER. 2½in. barrel, 3½in. flange, panel mounting. Scaled 0-100 in 50 equal divisions. **Price ONLY £3/10/-** each.

COMMUNICATION RECEIVERS

SKY CHAMPION S20R. This super Hallicrafter receiver covers 550 kc/s to 45 Mc/s (550 to 6½ metres) without gaps. Has bandspread tuning. R.F. stage, two I.F. stages, etc. Built-in power-pack for 200/250-volts 50 cycles A.C. mains operation. Complete with all nine valves, built-in speaker and ready for operation. Each set tested prior to despatch and demonstrated to callers. In case size 18in. x 8½in. x 10in. **Price £21,** plus 10/- carriage and packing.

SKY RIDER DEFIANT SX24 is similar to above but includes crystal I.F. filter and S meter, etc. Complete with valves and crystal for **£27/10/-,** plus 10/- carriage and packing. For further details send S.A.E.

COMMUNICATION RECEIVER R1155 for world-wide reception. Can be heard at any time during shop hours. Air tested prior to despatch. Brand new at £11/19/6. A few slightly used at £7/19/6.

TRAWLER BAND. R1155N, with super slow motion drive, available at **£17/19/6.** Carriage in original transit cases 10/6 extra on all models. Send 1/3 for full details and circuit.

A.C. MAINS POWER PACK OUTPUT STAGE enables the R1155 to be used to operate speaker from 200/250 volts A.C. without ANY MODIFICATIONS WHATEVER. All our Power Packs have heavy duty transformers, are complete with leads and Jones plugs and are guaranteed for 6 months.

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SAVE £££££'s Deduct 10/- when purchasing any R1155 and power pack together.

VISUAL INDICATOR TYPE 1 Ref. 10Q/2—the cross-over Left/Right indicator for D.F. operation and Loop Aerials Type 4, ref. 10B/420. Both Brand new and boxed. We have these items in stock and those interested in complete D.F. installations should contact us for quotations.

R.C.A. SPEAKER. 8in. P.M. unit in beautiful black crackle cabinet. Size 11½in. x 10½in. x 6in. A de Luxe job. **Brand new at 45/-,** plus 2/6 carr.

U.S.A. DYNOMOTOR. 12 volts D.C. input, 250 volts 60 mA. output. Weight 2¾ lbs. Size 4½in. x 3in. diameter. Ideal for car radio, mobile amplifiers, small transmitters, etc. All tested prior to despatch. **ONLY 22/6,** post paid.

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THE R1132A receiver covers 100-124 Mc/s with variable tuning. Very easily altered to other frequencies. Complete with all 11 valves. Requires only 250 volts and 6.3 volts when it is ready to operate. Complete circuit supplied. **Only 45/-,** plus 7/6 carriage. BRAND NEW. Will operate from our standard R1155 power pack using special lead, price 10/- extra.

POWER PACK NO. 3. Standard 19in. rack-mounted power packs for 200/250 volts mains operation. Paper smoothing, two heavy duty chokes, VU39 rectifier. Output 250 volts D.C. 100 mA., 6.3 volts 4 amps. Two types: Mark I with H.T. current meter at £4/4/-; Mark II with H.T. current and voltmeters at **£4/10/-,** carriage 5/-. Suitable for use with P48, R1132, R1481, R1392, R1155, etc. Lead for any specified set with Jones plugs, 10/- extra. All power packs guaranteed in working order.

TRANSFORMER BARGAINS. 350-5-350 volts at 180 mA., 6.3 v. 5 Amps and 5 v. 3 Amps. Standard 200/250 volt 50 cycle screened primary. Size 4in. x 4in. x 5in. Brand new and unused **29/6** plus 2/6 post. Filament Transformers—Standard tapped primary, two types—Type "A" 12 volts 1½ Amps., 6.3 volts 1½ Amps. Type "B" 12 volts 1½ Amp., 4 volts 1½ Amp. Either type **7/6** each.

H.R.O. 6 VOLT VIBRATOR PACK gives 165 volts 80 mA. smoothed D.C. Uses Mallory vibrator, 6X5, heavy duty smoothing choke, etc. In black crackle cabinet size 7in. x 7in. x 6in Brand new only **29/6,** plus 2/6 postage.

GROUNDED GRID TRIODES TYPE CV82—A few of these in stock.

C.R. TUBES for G.E.C. "Miniscope" price **35/-** each. New and Boxed

VARIACS semi-variable. Rated .8 kVA. oil filled. Adjustable for 30 volts above and below the mains input. **Price £5.**

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UNIVERSAL AVOMETERS MODEL 40—very little used, thoroughly checked and tested. First-class multi-range test meter for **ONLY £9/19/6.**

1 Milli-amp. 2½in. square panel mtg., 15/-

5 Milli-amp. M/c. 2½in. square panel mtg., 7/6

200 Milli-amp. M/c. 2½in. diameter flush panel mtg., 10/6.

20 Amps. 2½in diameter M/coil, 7/6.

20 Volts 2in. square panel mtg., M/coil, 7/6.

500 Milli-amps. Thermo-couple 2in. square panel mtg., 5/-.

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4 mfd. at 1,000 volts. Size, 4½in. x 4in. x 1½in., 5/-. New and boxed.

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BATTERY CHARGERS. Contained in black crackle case, size 6in. x 7in. x 12in., includes a heavy duty transformer, metal rectifier, 0-5 ammeter, on/off mains switch and 2 Slydlock fuses. 230 volts 50 cycles input; output 4 amp., 6 or 12 volt battery. The transformer, etc., is conservatively rated and the whole unit is of sturdy construction and super quality. Made to a very stringent specification, this equipment is well worth the price of **£4/19/6,** plus 5/- carriage and packing. **In brand new unused condition.**

METAL RECTIFIERS

Selenium 230 volts 60 mA at 5/-; 300 volts 100 mA. at **7/6**; RM2 at 4/3 or two for 8/-; RM4 at 17/-; Selenium Full Wave Bridge 6 or 12 volts—1 Amp. at **7/6**; 2 Amp. at 11/3; 3 Amp at **12/6**; 4 amp. at 15/-. Heavy duty selenium rectifier, square fins, size 8½in x 4in. x 4in. Two units in full wave bridge give 48 volts 10 Amps D.C. Brand new at £4 per pair.

COLLARO THREE SPEED AUTO CHANGER 3RC521 complete with two separate crystal heads BRAND NEW AND BOXED only **£9/19/6.**

GOODMANS AND B.T.H. 12in. 15 watt 15 ohm heavy duty speakers in stock. Brand new and boxed at bargain prices for callers

PUSH PULL OUTPUT TRANSFORMERS 15 watts, push-pull 6V6's to 15 ohms. A bargain for ONLY **7/6** each.

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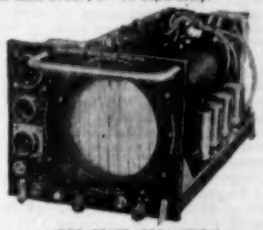
contains 3 EF50, 1 SU4G, 4 SP61 and a 6½in. C.R.T. type VCR517. This tube will replace the VCR97 without any alteration, is completely free from cut-off and has a more pleasant tube colour. Contains in addition a very large assortment of pots, resistors, condensers, etc. Tubes demonstrated. Supplied BRAND NEW (less relay) for only **67/6,** plus 7/6 carriage in original transit cases. **Original circuit supplied FREE** with each order, or 1/6 separately.



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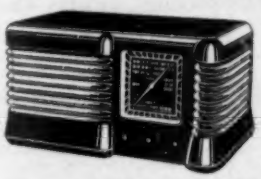

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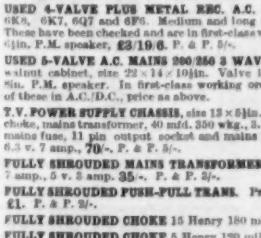

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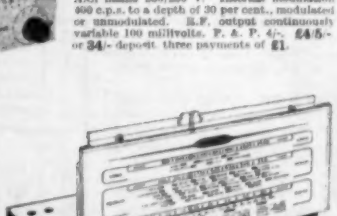

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350 mfd., 12 v. wkg.	**1/-**
16 mfd. 500 wkg., wire ends	**3/3**
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Smoothing Choke, 2 henry 150 mA. **3/6**. 250 mA. 2 henry, **5/-**; 350 mA. 10 henry, **10/6**; 250 mA., 8 henry **8/6**. 5 henry 250 mA., 60 ohms, **8/6**.

P.M. Focus Unit for any 9 or 12in. tube except Mazda 12in., with Vernier adjustment, **15/-**. P. & P. 1/6.

P.M. Focus Unit for Mazda, 12in., with Vernier adjustment **17/6**. P. & P. 1/6.

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465 kc. I.F.s, size 2½ × 1¾in. Q.110 removed from American equipment, **5/-** per pair. Standard 465 Kc. iron-cored IFs, 4 × 1½ × 1¾in., pair pr. **7/6**. Wearite standard iron-cored 465 Kc. IFs. 3½ × 1½ × 1¾in., pair pr. **9/6**.

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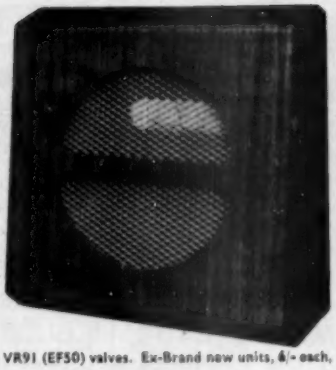

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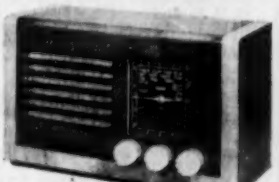

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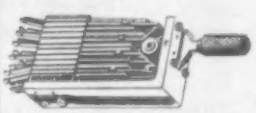
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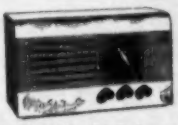

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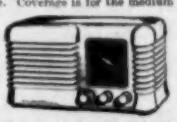

NOTE! *We would respectfully suggest to those interested in building this receiver that they send for OUR Instruction Booklet. Intending constructors can then judge for THEMSELVES how comprehensive this Booklet is. Instruction Booklet and Priced Parts List available at 1/-. This money will be refunded if the Booklet is returned as NEW within 7 days.*

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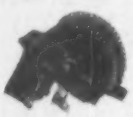

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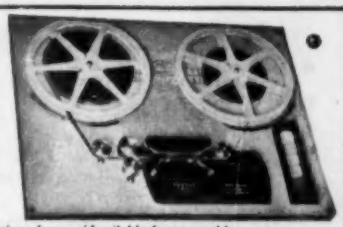

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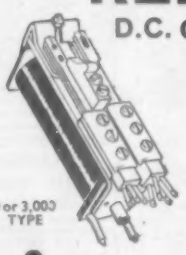

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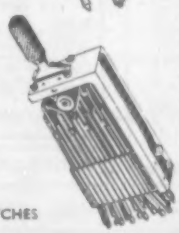

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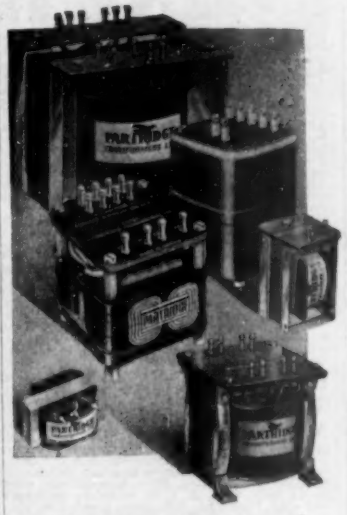

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PRE-AMP/RECORD units for use with Leak, Q.U.A.D., etc., with meter level ind. to suit Bradmatic, Truvox, etc., now £16; to suit Wearite, 17gns; this unit gives you first-class recording with playback via your RL-PL amp. AMPS. to suit Wearite 2A (EL84), 5 watts output, 21gns, and £32 for 12 watts P.P. with meter and Partridge out. trans. MOTEK amp. to spec. £11; others for Truvox, etc., 12 watts P.P., £21. HARDING ELECTRONICS, 190a, Mora Rd., London, N.W.2. [1858

POLLOCK lightweight m/c pick-up, response 40cs to 20 kc/s, h.f. resonance 25 kc/s approx.; complete set of parts for constructing head 25/-, plus 1/- postage and packing; building instructions, 5/-; sapphire stylus .001in or .0025in. 7/6; model also for thorns; 100:1 input trasformer, steel case, 20/- plus 1/- post, etc. —S.a.e. for details to A. M. Pollock, 14, Broomfield Lane, Hale, Cheshire. [1857

PICK-UP arm/pvt for Pollock m.c. pick-up head now available as a kit, price 26/-, post free; s.a.e. for details as above.—A. M. Pollock, 14, Broomfield Lane, Hale, Cheshire. [1901

MAGNETIC recorders, all types, new and secondhand for sale; hire service in greater London area only; mechanical and electronic repairs carried out by specialists; "Magnegraph" limpet telephone pick-ups, suitable for all types of recorder, 25/-; tape storage racks for 12 reels, 37/6; B. & H. recording wire, new and used, from 15/- reel; tape, accessories, etc.; full details s.a.e.—The Magnegraph Recording Co., Ltd., 1, Hanway Place, W.1. Tel. Langham 2156. [0236

GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

WEARITE tape-deck, new condition; £27, or near offer.—Box M.O. 2221. [2199

FOR sale, Bradmatic tape, deck, three heads, almost new; £30.—Box 2301. [2220

GRUNDIG two-speed reporter, as new, complete tape, mike, list £84; £65.—Taylor, 125, Manchester Rd., Denton, M/C. [1880

COMPLETE portable disc recorder, 78/33⅓ rpm amplifier, level meter, Monitor speaker, in case; North London; £35.—Box 2082. [2139

GRUNDIG 700 2-speed tape recorder, complete, as brand new, purch. late Sept., list price £84; will accept £69.—Box 1814. [2099

PHILLIPS tape recorder, type EY3540, in two cases, complete with microphone and tape, cost £200; £100.—Box 2210. [2193

DISC recording and reproducing console, twin tables, M.S.S. cutting gear, ribbon mike; £300, o.n.o.; s.a.e. photo.—Box 2321. [2245

SOUNDMIRROR magnetic tape recorder, as new, complete with four spools of tape and Acos mike; £65, or near offer.—Ward, 129, Light Oaks Rd., Salford, 6. [2200

QUALTAPE deck, latest model, as new, complete with head-lift transformer, osc. coil and circuits, £12 or offers.—Ross-Smith, 467, Whirlowdale Rd., Sheffield. [2183

MOBILE disc and tape recording equipment, etc., profitable business; bargain owing to death of owner, £450; delivery arranged.—Higher Cransow Farm, St. Genny's, Nr. Bude, Cornwall. [2110

BOOSEY & HAWKES type wire recorder combined with record player, excellent condition; £28.—Burgess, Lane & Co., Block J, Sunleigh Wks., Sunleigh Rd., Wembley. Wem. 2378. [2155

UNIQUE opportunity to obtain first-class high quality tape recorder, well-known M.S.S. PMR/1, cost £150 new; first-class condition; can be seen London; £95 or near offer. Box 2313. [2244

CONSOLE tape recorder, Wearite series II deck, Wharfedale W10/GS speaker, Reslo ribbon microphone, built to professional standards; £70 or nearest.—Please, Station House, Saffron Walden, Essex. [2253

12IN recording blanks, Grade 1, new, 5/3 ea.; Stellite cutters, packets of 6, 4/6; quantity of tape, disc and amplifying equipment, feeders, mikes; please state requirements; s.a.e. please.—Matthews, Bentworth Priors, Tower Hill, Dorking. Tel. Dorking 3426. [2224

COLLARO AC.47 gram unit, magnetic pickup, £5; ditto coil pickup, £10; AC.47 motor and turntable only, £3/10; Garrard AC.6 stroboscopic turntables (pair), £7 each; Polyton motor, £1; Vitavox K.12/20 loudspeaker, £8/10 all unused.—R. B. Ransome, Sproughton, Nr. Ipswich. [2113

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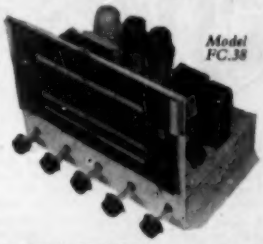

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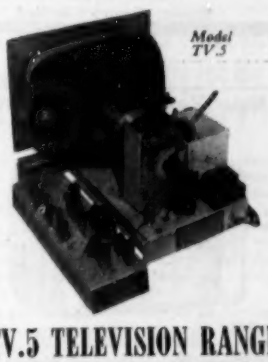

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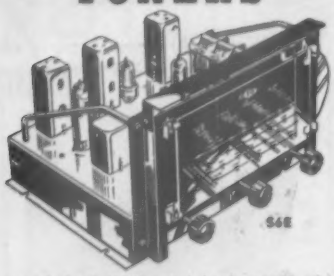

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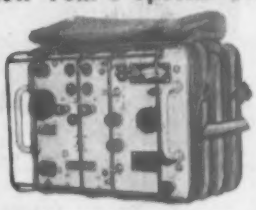

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WANTED, Wilcox Gay V.F.O. units in new or modified condition.
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WANTED, receivers A.P.R.4, also T.N. 16, 17, 18, 19, etc., and any radio test gear.—LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159 [0176

PERMANENT magnet attenuators, or motors, small multi-pole.—Jolly, Edmondsham, Dorset. [2126

WANTED, RCA 4331 transmitters.—P.C.A. Radio, Cambridge Grove, Hammersmith, W.6. Tel. Riverside 5279. [0097

WANTED, Cin-tel or similar synchronous clock or timer, any condition.—Davies, 14, Lyttelton St., Worcester. [2112

WANTED, Avo meter, 1135 receiver, tape recorder, good working order essential.—212, High St., Harlesden, N.W.10. [2165

WANTED, R.C.A. transmitters, all types or any R.C.A. components, including chassis and metal work.
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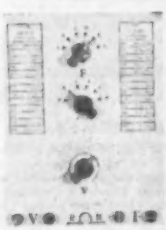

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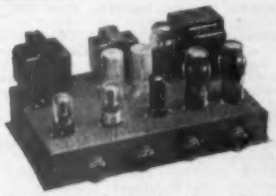

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Will any manufacturer who can deliver Radio Receivers operating from a 6 Volt battery (accumulator), middle, short and long waves, at the price of $33-$35 c.i.f. Piraeus, Greece; also Radio Receivers operating from 1.5 Volt and 90 Volt dry battery, address offers to: P.A.A., Box 1858, c/o Wireless World.

CAPACITY AVAILABLE

PRODUCTION WINDING Co., Brentwood, Essex, will have capacity available in the near future for all types of coil winding; assembly of light electrical equipment or sub-assemblies; specialists in quantity winding of armatures and stators.—Tel. Brentwood 3555. [2206

CAPACITY available; manufacturer of transformers up to 3 k.v.a. to R.C.S. 214, chokes, solenoids, etc.; have capacity available and invite enquiries from manufacturers; small runs of electronic assembly also undertaken; 1/6th h.p. induction motor in production, good delivery.—Avis & Bagge, Ltd., 11, Gosbrook Rd., Caversham, Reading. Tel. 71763. [2076

MISCELLANEOUS

METALWORK, all types cabinets, chassis, racks, etc., to your own specifications; capacity available for small milling and capstan work up to 1in bar.—PHILPOTT'S METAL WORKS, Ltd. (G4B1), Chapman St., Loughborough. [0286

TAPE recordings transferred to disc, very reasonable prices, guaranteed satisfaction; write.—"Personaldisc," 50a, Powney Rd., Maidenhead, Berks. [2092

ALUMINIUM chassis, punched to your requirements; for prices see November issue "W. World."—Wood & Toy, 51, Whinfield Rd., Worcester. [2163

EX-GOVERNMENT steel instrument cases, copper plated and finished grey, size 23in long, 10in high and 7in deep; 10/-, plus 2/6 carriage.—Weatherhead's, Bletchley, Bucks. [2088

A HIGH vacuum impregnation unit or single or batch coil impregnation service to R.I.C. specification 214 or individual requirements.—Blickvac, 505, Lordship Lane, S.E.22. Tel. Forest Hill 7089. [0310

YOUR own tape recording transferred to disc. —Write, call or 'phone Queensway Private Recording Studios, 123, Queensway, W.2. Tel. Bay. 4992. Studio recordings, tape recording service. [2187

PLYWOOD—Hardboards. Send s.a.e. for free price lists and samples, including ¼in mahogany ply 10d sq ft, sheets 72in×36in; hardboard all sizes, from 6d sq ft; free delivery (100 miles).—N. Gerver, 2-10, Mare St., London, E.8. Amherst 5806. [1742

ENGRAVING amateurs and trade could take the opportunity of engraving problems in the future by getting in touch with A.O. Engraving, 19a, Windmill Rd., London, S.W.18. Bat. 5793. Brass, bronze, erinoid, Perspex dials; one knob or repetition equally entertained. [0034

COPPER wires enamelled, tinned. Lits, cotton, silk covered, all gauges; B.A. screws, nuts, washers, soldering tags, eyelets, ebonite and laminated bakelite panels, tubes, coil formers; Tufnol rod; headphones flexes, etc.; latest radio publications, full range available; list, s.a.e.; trade supplied.—Post Radio Supplies, 33, Bourne Gardens, London, E.4 [0138

MOBILE EQUIPMENT

PYE mobile radio telephone.

ONE complete Pye PTC.258 equipment comprising fixed station, three mobile units, 10-watt transmitters, 12-way public address amplifiers, operation 12 volt D.C., frequency 50-100 Mc/s, handbooks, etc.; all in perfect tested condition.

McELROY ADAMS MFG. GROUP, Ltd. (Sole concessionaires U.K. for Hallicrafter Communication Equipment), 46, Greyhound Rd., London, W.6. Cables: Hallicraft, London. Tel. Fulham 1138/9. [2164

NOTICES

BELCHER (RADIO SERVICES), Ltd., announce that, in order to handle the number of television aerial installation orders they are now receiving for Bournemouth and district and in anticipation of the Isle of Wight television transmitter next year, they have established a new branch at 14, St. Paul's Lane, Bournemouth (Tel. Bournemouth 5219); this Belcher branch (the seventeenth) will handle all aerial installation orders and television maintenance for Bournemouth and the surrounding area and will be under the control of Mr. L. H. T. Binden. [2214

PATENTS

THE proprietor of British Patent No. 573513, entitled "Multiple section electronic tube and method of making it," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern & Carlberg, 14, East Jackson Boulevard, Chicago 4 Illinois, U.S.A. [2191

AGENCIES

AGENTS calling on radio dealers, departmental stores offered an additional first-class line, completely new; exclusive territories now available throughout the British Isles.—Box 1731. [2036

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

RADIO Mechanics and Radio Testers.—BRITAMER, Ltd., 48/56, Bayham Pl., Camden Town (nr. Mornington Cresc. Tube Stn.), have a number of interesting jobs for men, preferably experienced in R.A.F. ground radar equipment, also radio chassis testers. [2208

PERSONAL SHOPPERS ! !

See our NEW Showroom (address below) and inspect these and hundreds of additional bargains.

Send 3d. for Bargain List.

1,500FT. BEAM FOCUSING TORCH

Highly polished nickel-plate finish, heavy duty, 14in. long, five standard U.2 batteries. Brand new. **Complete with Ever-Ready batteries, 19/11.**

400FT. BEAM TORCH

Fully focusing, nickel-plated. 7¼in. **Complete with Ever-Ready batteries, 9/11.**

SELENIUM METAL RECTIFIER.

Suitable for 2, 6, and 12 v. battery chargers, model planes, etc. Max. capacity 15 v. at 1 amp. New and boxed. **9/6.**

DOOR CHIMES

Frustrated Export Order enables us to offer these attractive door chimes at BELOW COST, suitable for operation direct from 200/240 Volt Mains. Brand New, in original cartons. **35/-.**

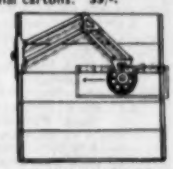
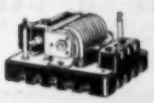


CHART BOARD

Ideal as drawing board. 17in. sq. complete with pantograph arm, protractor head and Perspex scale. Each **25/-.**



ACCUMULATOR CUT-OUT

12 or 24 v., 60 A. Ex-R.A.F., originally cost over £6 each, suitable for battery charging, etc. Limited quantity at **15/-** each.

"MEGGER" CIRCUIT TESTING OHMMETER.

4½ v. battery operated, 2 ranges 0-1,000 ohms and 100-200,000 ohms. Size 5½ x 4 x 2½in., complete with fitted leather case, test prod and full instructions. Unrepeatable at **£3/19/6.**

Set of TWIST DRILLS 9 drills, ½—¼in., complete with plastic case and stand. Brand new. **4/6**

OHMMETER. 4 scales, 2½ in. diameter, reading 0-5,000 ohms, 0-60 mA., 0-1.5 v., 0-3 v., suitable for continuity testing. Will operate from 1.5 v. battery, strong case with full instructions engraved on back. Brand new, **19/6.** Carrying sling, 1/- ex.

TOOL BOX

U.S.A. manufacture size 18in. x 12in. x 5in. Strongly made waterproof ply, all external edges reinforced. Subdivided as illus., leather carrying handle. Outside resprayed green

17/6

ALL ITEMS CARRIAGE PAID IN U.K. ONLY

TERMS—CASH WITH ORDER. C.O.D. 1/- EXTRA.
Phone Orders Accepted—Money Back Guarantee

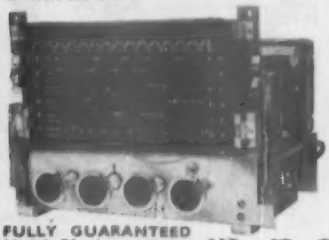
SHERMAN'S SUPPLY CO. (W.8)
479 HARROW RD., LONDON, W.10
LADbroke 1718.

DIRECT FROM THE MANUFACTURER

Dulci Radio/Radiogram Chassis

A/C 100-120 & 200-250 VOLTS.

All chassis 11½in. x 7in. x 8½in. high. Latest type valves 6BE6, 6BA6, 6AT6, 6B W6, 6X4 Flywheel tuning. Negative feedback over entire audio section. Engraved knobs. 3 Tone position for Radio and Gram.



FULLY GUARANTEED

Model B3, Long, Med. Short (5 Valves)	£12 . 12 . 0
B3 Plus Push Pull Stage (6 Valves)	£15 . 15 . 0
B3 Double Feature P/Pull & RF Stage (7 Valves)	£18 . 18 . 0
Model B6 Six Wavebands Med. L. 4 Short (8d-Spread)	£15 . 15 . 0
B6 Plus Push Pull Stage (6 Valves)	£18 . 18 . 0
B6 Double Feature P/Pull & RF Stage (7 Valves)	£23 . 2 . 0

ALL PRICES TAX PAID

Escutcheon for 9in. x 5in. dial, 4/9 extra. Matching speakers P.M. type 3 ohms 8in. or 10in. available. Money back guarantee. Free particulars from the Manufacturers.

THE DULCI CO. LTD.

97 VILLIERS ROAD, LONDON, N.W.2

Telephone: Willesden 7778

9 Hanworth Trading Estate, Feltham, Mdx. Tel. Feltham 2657

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Fine Cabinets

and woodwork of every description for the Radio and allied trades

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HIGH GRADE TRANSFORMERS

FOR ALL PURPOSES

SINGLY OR IN QUANTITIES

TO YOUR SPECIFICATION

VARNISH IMPREGNATED

BAKED WINDINGS

WITH OR WITHOUT TAG PANELS

GOOD DELIVERIES

Our rewind dept. will handle your repairs promptly and efficiently.

P. HOWORTH

(Dept. W.W.)

51 POLLARD LANE · BRADFORD

Tel.: 37030

SITUATIONS VACANT

RADIO Technician required as

SIGNALS Assistant Inspector of Police by Nyasaland Government for one tour of 2-3 years with prospect of permanency; salary, etc., £651 rising to £1,103 a year; commencing salary according to experience; outfit allowance £50, uniform allowance £10 a year, free passages; liberal leave on full salary; candidates must be unmarried, between 21 and 30 years of age, of good education and physique, not below 5ft 6in in height, normal vision without glasses; they must have a sound knowledge of H.F. and V.H.F. fixed and mobile simplex and duplex radio telephone systems and low power petrol/electric chargers and alternators; knowledge of morse and ability to instruct trainees in radio subjects desirable.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M1/36023/WF. [2239

BRITISH Electricity Authority.

SOUTH-EAST Scotland Division.

GENERAL Assistant Engineer (Telecommunications) required in the Technical Department at Divisional Headquarters, Portobello.

APPLICANTS should possess H.N.C. or equivalent and have experience in installation and maintenance of automatic telephone equipment employing both D.C. and V.F. signalling; some knowledge of carrier frequency equipment and V.H.F. radio would be an advantage.

SALARY scale £505–£656 per annum (N.J.B. Class AX/BX/8); placing according to experience; pension scheme.

APPLY in writing by January 8th, 1954, to Divisional Controller, British Electricity Authority, South-East Scotland Division, British Electricity House, High St., Portobello, Midlothian. [2219

RADIO Technicians required as

SIGNALS Assistant Inspectors of Police by the

GOVERNMENT of Kenya for one tour of two years, extending to three years by mutual consent and with possibility of permanency; commencing salary, etc., according to previous experience in scale £796 rising to £1,154 a year; gratuity (at least £162 after two years' service) payable on satisfactory final completion of service; outfit allowance £30; uniform allowance £10 a year; free passages; liberal leave on full salary; candidates aged 20-35 should be at least 5ft 7in without footwear, have normal vision without glasses and be of good education; they should possess a sound knowledge of the installation and maintenance of modern low and medium powered V.H.F., static and mobile equipment, H/F transmitters and receivers, petrol generators and diesel electric sets; previous police experience not necessary.—Apply in writing to the Crown Agents, 4, Millbank, London, S.W.1, stating age, name in block letters, if married or single, full qualifications and experience and quote M1/35931/WF. [2238

ELECTRICITY SUPPLY BOARD.

VACANCY: Telecommunications Section.

THE Electricity Supply Board has a vacancy in its head office, Dublin; the position (pensionable) is associated with the carrier telephone and telemetering equipment of its high tension system.

APPLICANTS should have a University degree in electrical engineering or be corporate members of the I.E.E. and should also have a sound knowledge and experience of carrier equipment, automatic exchanges, cable laying and testing.

CONSIDERATION may be given to applicants who have qualified for graduateship of the I.E.E. and possess the final certificate in telecommunications engineering of the City and Guilds of London Institute and who have, in addition, extensive experience of the type indicated above.

THE commencing salary will have regard to qualifications and experience and, in the case of a fully qualified candidate will be at an appropriate point in a salary scale at present £540 per annum to £990 per annum.

APPLICATIONS giving date of birth and full details of technical training, qualifications and experience should be addressed to the Personnel Officer, 27 Lower Fitzwilliam St., Dublin.

PATRICK J. DEMPSEY, Secretary.

1st December, 1953. [2198

NEWCASTLE GENERAL HOSPITAL.

REGIONAL Cardiovascular Department.

TECHNICAL assistant required for research in cardiology. Duties will involve the setting up care and operation of electromanometers and recording instruments, and assistance with ballistocardiographic recording. Practical knowledge of electronics is essential. Previous experience of Physiology would be an advantage. Three-year appointment.

SALARY £500×£20—£600 per annum according to experience.

APPLICATIONS stating age, qualifications and experience, together with one copy of two recent testimonials, should be sent to the Secretary, Newcastle General Hospital, Westgate Road, Newcastle-upon-Tyne, 4. [2179

DEVELOPMENT engineer required; design experience of H.F. and V.H.F. transmitters essential.

GOOD theoretical background and knowledge of production methods desirable.

APPLY, with full details, to Personnel Manager, Pye Telecommunications, Ltd., Ditton Works, Cambridge. [2111

SOUTHERN RADIO'S WIRELESS BARGAINS

TELESONIC 4-Valve Battery Portable. Complete with 4 Hivac Valves. In Metal Carrying Case. Easily convertible to Personal Portable. £2 including conversion Sheet.

TRANSMITTERS-RECEIVERS. Types "38" Mark II and III. "18" Mark III. Still available, as previously advertised. ALSO R109 RECEIVERS. See October issue of "W.W."

MINISCOPES. G.E.C. M8618. Brand New Complete in Carrying Case with plugs. £12/10/-.

BOMBSIGHT COMPUTERS. Just arrived new parcel of this USEFUL Unit. Ex-R.A.F. Brand New. Contains GYRO, MOTORS, REV. COUNTERS, GEAR WHEELS, ETC., ETC. Worth many Pounds to Model Makers, Experimenters, etc., etc. £3/5/-.

CRYSTAL MONITORS. Type 2. Brand New in transit case. Less Crystals. 8/-.

LUFBRA HOLE CUTTERS adjustable ⅞in. to 3⅛in. For use on Wood, Metal, Plastic, etc. 5/9.

THROAT MICROPHONES Brand New. Magnetic with Long Lead and Plug. 4/6. Button Type ex-U.S.A., 4/6.

RESISTANCES. 100 ASSORTED USEFUL VALUES WIRE-ENDED. 12/6 per 100.

CONDENSERS. 100 ASSORTED VALUES TUBULAR, METAL AND MICA. 15/- per 100.

PLASTIC CASES. 14in. by 10½in. Transparent. Ideal for Maps, Display, Photos., etc., 5/6.

STAR IDENTIFIERS. Type 1 A-N. Covers Both Hemispheres. Complete in Case. 5/6.

WESTECTORS. Wx6 and WI12. 1/- each.

AERIAL FILTER UNITS. MARCONI. P.O. SPECIFICATION. 4/6.

CONTACTOR TIME SWITCHES. 2 impulses per sec. Thermostatic Control. Complete in Sound Proof Case. 11/6.

REMOTE CONTROL for use with above. 7/6.

DIMMER CONTROLS. Bakelite covered. Wire Wound. Brand New. 1/3 each.

MAGNETIC RELAYS SWITCH. Bakelite. 5c/723. 2/6.

SPECIAL OFFER TO EXPERIMENTERS. TWELVE METERS AND AIRCRAFT INSTRUMENTS. Only need adjustment; or cases broken. TWELVE INSTRUMENTS (Including 3 brand NEW Aircraft instruments). 35/-.

SOUTHERN RADIO SUPPLY LTD.

11, LITTLE NEWPORT STREET, LONDON, W.C.2.

GERrard 6653

RADIO & TELEVISION COMPONENTS

WE OPERATE A PROMPT & EFFICIENT MAIL ORDER SERVICE.

"VIEW MASTER" & "TELE-KING" specialists

Easy terms available.

JAMES H. MARTIN & CO.,

FIRBTHWAITE, NEWBY BRIDGE

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THE

DESIGN and DEVELOPMENT

of specialised equipment for Research and Industry.

DUN (electronics) & CO.,

17 Victoria Gardens, London, W.11. Park 6636

FIRE!

HIS LIFE LOST FOR LACK OF

NU-SWIFT!

"Door jammed in crash... car blazing but window open... he could have been saved if only... it was a dreadful sight... I enclose order... I shall never be without my Nu-Swift."

NU-SWIFT LTD · ELLAND · YORKS

In Every Ship of the Royal Navy

SHORT WAVE RECEIVERS R103a. For use on 100/110 volts 230/250 volts A. and 12 volt battery. Comprising six valves and built in vibrator unit Covering 1.7 mc/s. to 7.5 mc/s. Brand new in perfect working order £9/15/- plus 5/- carriage.

BRAND NEW AND BOXED METERS AS UNDER.
0/3500 volt meters D.C. Moving Coil 3in. scale 4in. stand off 20/- each.
0/6 amp. Thermo Couple 2½in. flush, 7/6 each.
0/30 M/a Moving Coil D.C., 10/- each.
0/15 Volt A.C. Moving Iron 2½in. Flush 15/- each.
0/300 M/a. Moving Coil D.C. 2½in. Flush, 10/- each.
0/200 M/a Moving Coil D.C. 2½in. Flush, 10/- each.
0/1 M/a. Moving Coil 2in square, 15/- each. Postage 9d. extra on all meters.

LOUDSPEAKING TELEPHONE UNITS. These units are complete with 1 Large Press Button TRUVOX Carbon Mike and C.L.R. Headphones. Working off 12 volt battery they can be used to speak to four positions at the same time. Brand new in cases at only £1/15/-, carr. free.

BUZZER VALVE UNITS Type 2. Can be used as Morse Training Aids with facilities for interference input. Less valves (2) 7/6 each, carr. free.

MIDGET ROTARY TRANSFORMERS. As previously advertised, 11.5 volt input 365/310 volt 30 M/a. output. 15/- each, post 1/-.

SIGNALLING TORCHES. Still a few available at 3/9 each, post 9d.

CUT-OUTS. 12 and 24 volt 60 amp., as previously advertised. 10/- each, post 9d.

0/50 A.C. MOVING IRON 4in. PANEL MOUNTING METERS. Last few now offered at the knock-out price of 17/6 each, post 1/-.

TELEPHONE OPERATOR HEAD AND BREAST SETS. Twin Phones No. 2, 12/6 each, post 1/-.

TAPE DECK CABINETS. Finished in Imitation Lizard Skin. Colours Green, Red, Grey, Blue, Brand New, with space for amplifier, £3/12/6 each, Carriage 2/-. Please state alternative colour.

COLLARO AUTO-CHANGERS, Still a few left to clear at £9/19/6 carr. free.

SOLDER. 1lb. reels of 40/60, 5/- per reel, post 1/-.

EARPHONES. 60 Ohm. C.L.R., 5/- pair, and 4,000 Ohm, 7/6 pair, post 1/-.

JONES PLUGS. 8-way chassis mounting, 7/6 doz. 8-way with covers, 9/- doz., 4-way chassis mounting, 6/-, post 9d. doz.

JONES SOCKETS. 8-way chassis mounting, 7/6 doz. 8-way with covers, 9/- doz. Post 9d. doz.

JONES PLUGS AND SOCKETS, M.DGET. 12-way plug shrouded, 2/6 pair, post 3d.

BRAND NEW. 50 mfd. Motor Capacitors. 10/6 each, post 9d.

Wishing all our customers a Happy and Prosperous New Year and looking forward to your continued support.

UNIVERSAL ENGINEERING CO.
Havelock Works, Havelock Place, Harrow, Middlesex. Harrow 1432.

YOUR METER DAMAGED?

Leading Electrical Instrument Repairers to the Industry

Contractors to The Ministry of Supply

Repairs by skilled craftsmen of all makes and types of Voltmeters, Ammeters, Microammeters, Multirange Test meters, Electrical Thermometers, Recording Instruments, etc. Quick deliveries—for speedy estimate send defective instruments by registered post to:—

L. GLASER & CO.
Electrical Instrument Repairers
76-100 ALDERSGATE STREET, E.C.1
(Tel.: MONarch 6822)

SITUATIONS VACANT

ELECTRONIC engineers are required by THE ENGLISH ELECTRIC Co., Ltd., Luton, for work on a high priority defence project. Applicants will be required to undertake the engineering of circuitry already developed, which involves close liaison with, and the progressing of work through, the drawing office and production department. Applicants with experience of the engineering of radar and/or aircraft electronics for production will be especially welcome. The posts are permanent and progressive and a staff pension scheme is in operation. Applications to Dept. C.P.S., 336-7, Strand, W.C.2, quoting ref. 1211. [2114

BRITISH ELECTRICITY AUTHORITY, LONDON Division.
APPLICATIONS are invited for the following superannuable post. Salary including London Allowance, and conditions of service in accordance with N.J.B. Agreement. Schedule C. Qualifications entitling to Graduate Membership of the I.E.E. an advantage.
GENERAL Assistant Engineer—Communications at Divisional Headquarters.
DUTIES will include maintenance of Private Communications System using Line, Teleprinter and Radio techniques. Previous experience of this work or with a telephone manufacturer desirable. Preference given to holders of H.N.C. in engineering or scientific equivalent.
SALARY (subject to superannuation deductions) within the range £526/1 to £670/19, rising to ultimate maximum £740/14. Opportunities occur for promotion.
APPLICATION may be made on form obtainable from Divisional Secretary, B.E.A., London Division, Generation House, Great Portland St., W.1., and be received within 14 days of this advertisement. [3175

WIRELESS operator/mechanic required for the NYASALAND GOVERNMENT Aviation Department for one tour of 2 to 3 years with prospect of permanency. Salary, etc., in scale £651/10 rising to £1,103 a year. Outfit allowance £30. Free passages. Candidates, over 25 and preferably single, must be able to transmit and receive Morse at 25 w.p.m. plain, 20 g.p.m. code. They must have a knowledge of the maintenance of radio transmitters and of diesel electric plants up to 20 KW., the installation and maintenance of V.H.F. D/F. equipment, the theory and design of serial systems, and of radio theory and workshop experience.
WRITE to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30265/WF. [2107

SENIOR microwave engineers are required by:—
THE ENGLISH ELECTRIC Co., Ltd., at Luton, for work on a high priority defence project. Applicants should have a good theoretical background to degree standard and experience of design or engineering of microwave equipment for development work on aerial and receiving systems. This work includes investigations of new methods of construction with a view to miniaturisation and weight reduction, the design of new components and engineering to the production stage. Successful applicants will be required to take charge of a group and to be responsible for one or more aspects of the system. The posts are permanent and progressive and a staff pension scheme is in operation. Applications to Dept. C.P.S., 336-7, Strand, W.C.2, quoting ref. 1160B. [2115

FORCES Broadcasting Service (War Department Employment).
APPLICATIONS are invited by the War Office from men, British only, for junior technical appointments in the Middle East for a minimum period of three years; salary scale £330-£505 per annum plus Foreign Service allowance; starting salary fixed according to exp. rience, applicants should be experienced in or have knowledge of one or more of the following: Installations, operation and maintenance of medium and short-wave transmitters of medium power; design and installation of aerial arrays; disc and tape recording; studio balance and control.
APPLICATION forms and further details can be obtained on written application only from War Office (AG 3 ENT), London, S.W.1.
CLOSING date, January 22, 1954. [2144

LEADING London X-ray company has vacancies for the following staff:—
ENGINEER or Physicist, Graduate, with experience of light engineering and preferably medical radiography, as assistant to chief engineer. Candidate otherwise acceptable will be given training in radiography. Ref. T.A.
TECHNICAL Writer, with knowledge of engineering and electrical circuits to prepare instruction manuals for X-ray equipment. Knowledge of medical radiography an advantage. Ref. W.
DRAUGHTSMEN, to prepare X-ray department layouts, general arrangement drawings of simple apparatus, and diagrams of instructions. Ability to sketch in perspective and familiarity with circuit diagrams an advantage. Ref. D.
WRITE giving appropriate reference, age, details of experience and salary required, to Box 2265 [2215

EXPERIENCED television engineer required, driving essential.—Hurst, Son & Page, Ltd., 16, Market Place, Boston. [2145

TELEVISION engineer, thoroughly experienced all makes; preferably car owner; rate of pay only limited by ability.—Box 2252. [2207

DUKE & CO.
621 ROMFORD RD. LONDON, E.12
Phone : GRAngewood 6677
MONEY BACK GUARANTEE

RECTIFIERS. T.V. type. Salvage, guaranteed. 11/9. 300 volt at 250 m/a., also 250 volt at 60 m/a., 8/9. 180 volt at 40 m/a., 3/9. Post 1/-.

TRANSFORMERS. I.F.s 465 kc/s, new, 2/9 each. O.P. salvage trans. 1/6. Pick-up trans., E.M.I. type, new, 3/9. Microphone trans., cased, ex-W.D., 3/9. Car radio trans., 5/9. Post 1/- extra.

CRYSTALS. Germanium. Brand new, made by B.T.H. Give first class results. SPECIAL OFFER 2/3. Post 6d. FREE CIRCUITS.

INDICATOR UNITS. Ex-W.D., but brand new condition. Valves and C.R. tubes only have been removed. Chassis, valve-holders, resistors, condensers, etc., alone are worth more than our price. Units include Design "L." type 6C. BARGAIN at 12/6 each. Carriage 4/6.

POWER UNIT 857, new, 22/6, less valves. With 11 valves, 77/6.

METERS. Ex.-W.D. aircraft oil temperature gauges with 10 ohm Ratiometer Movement. This is a 100 micro-amp movement which can be easily re-scaled, full instructions supplied free. 2½in. square 12/9, post 1/3.

9/6 AMPLIFIER. Bargain. Brand new (ex-W.D.* unused). Contain EF36, two transformers, 400 ohm relay, volume control, various condensers, resistors, etc. Case measures 5 × 5in. Post 1/6.

RADIO-TELEPHONES. Brand new transmitter/receiver, 53-75 mc/s. Visual range. Valves 1c6 (2) and 9c6. Complete in canvas carrying case, and individually boxed in heavy wooden transit case. Works off set of dry batteries, or vibrator pack from 12-volt accumulator. Batteries or vibrator pack store inside unit. SPECIAL PRICE £9/17/6, or £18/17/6

per pair, less batteries or vibrator. BARGAIN OFFER of £21 per pair with vibrators. All units supplied complete with telescopic aerial, tape measure, and tuning instructions.

EXTENSION SPEAKERS. Brand new 6½in. P.M. speaker (low impedance). Mounted on polished and veneered baffle stand or normal box type cabinets, gold fret. 5ft. lead ready connected. ONLY 19/9. Post 1/9.

SPOTLIGHTS. Butlers, ex-W.D., 8/9. Also side lamps, infra-red glass ideal tail lamps. New, ex-W.D., 1/9. Post 9d.

TUNING CONDENSERS. Two gang. 0.0005 mfd., standard size. Store soiled, but all tested. CLEARANCE OFFER, 2/9. Post 9d.

MICRO-SWITCHES. New American miniatures, 250 volts, 5 a., 1½ × 1in. BARGAIN OFFER, 3/6 each.

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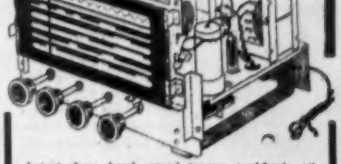

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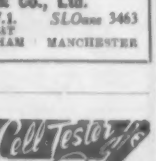

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APPLICATIONS, which will be treated with the strictest confidence, should be sent to Dept. C.P.E., 336-7, Strand, London, W.C.2, quoting Ref. No. S.A.34A. [2211

THE STEEL COMPANY OF WALES, Ltd. (Tinplate Division), Trostre Works.

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THE Supt. Labour and Wages, The Steel Company of Wales, Ltd. (Tinplate Division), Carmarthen Rd., Swansea. [2225

AIR TRAINERS, Ltd., Bicester Rd., Aylesbury, Bucks, have immediate vacancies for:—

ENGINEERS and design engineers.

QUALIFICATIONS and experience: Some years' experience in electronics, preferably but not necessarily with H.N.C. or G.C.E.; advanced level. Alternatively, graduate in physics or engineering with less experience.

DUTIES: Interesting work with other design engineers or on own initiative under senior design engineer on flight simulators and other development projects involving electronic and electro mechanisms.

WRITE fully to the Personnel Officer. [2120

FERRANTI, Ltd. (Computor Dept.), Moston, Manchester, have vacancies for the following:—

(1) ELECTRICAL Engineers possessing at least a good Honours Degree for development work on large-scale electronic digital computers. Ref.: DCD.

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THE work might also be regarded for some candidates as post-graduate training in electronic equipment prior to joining the development sections of the department. Ref.: DCM.

PERMANENT staff appointments with pension benefits. Application forms on request from Mr. R. J. Hebbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. [2095

ELECTRICAL Manufacturers at Enfield, Middlesex, require the following personnel for their Electronic Development Laboratories.

SENIOR Designer Draughtsman, age 28/40 years, to take charge of Development Drawing Office; must have good mechanical background with experience and knowledge of electronic equipment and some evidence of inventive ability; experience of working to I.D.P.15 an advantage.

ELECTRONIC Development Engineer, age 28/40 years with knowledge of physics and experience of Government Contract work; H.N. certificate, B.Sc. or A.M.I.E.E.; opportunity for original development work in radiation monetors (iron chamber type).

ELECTRONIC Development Engineer, age 28/40 years, B.Sc. or Grad. I.E.E. for low frequency and measuring equipment with some knowledge of ultrasonics and H.F. oscilloscope design.

WRITE giving full particulars of qualifications, experience and salary required to—Box 2302. [2221

TV engineers for West End, able to drive; improvers also required.—Keith Prowse, Ltd., Colquhoun House, Broadwick St., W.1. [2227

RADIO and TV service engineer, permanency with good salary offered to man of integrity and experience.—H. R. Bourton, 10, Wellsway, Bath. [2125

RADIO and television engineer required, fully experienced all makes, for bench and outside; good driver, clean licence; good salary, references.

ELECTRICAL SERVICE (EDGWARE), LTD., 117, Edgware Rd., W.2. Pad. 2342. [1726

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APPLICANTS must have first-class mechanical and electrical engineering knowledge; only top rate men please apply to Managing Director, A.B. Metal Products, Ltd., 16, Berkeley St., London, W.1.

APPLICATIONS will be treated in strict confidence. [2148

DEVELOPMENT engineer, age 25 to 30, with experience of radiocommunication equipment, preferably holding Higher National Certificate or equivalent, required by firm in London S.E. area; state age, qualifications, experience and salary required.—Box 1836. [2105

APPLICATIONS

are invited for a number of senior positions in the Guided Weapon field. Posts are permanent and will be offered to suitable applicants who have either at least 5 years experience in industry or are Graduates with two or more years experience.

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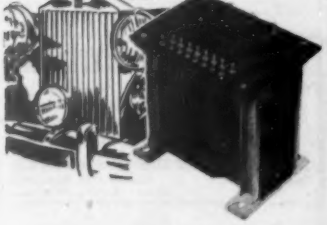

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THE ENGLISH ELECTRIC Co., Ltd., LUTON, have vacancies for the following technical staff on an interesting, high priority defence project:

(1) SENIOR Radar Engineers.
APPLICANTS should have a sound theoretical background and have had considerable experience in the operation, maintenance and modification of experimental radar systems in the field. Ref. 1190A.
(2) ELECTRONIC Trials Engineers.
APPLICANTS should have experience of high frequency communication equipment and be prepared to accept responsibility for its installation and subsequent trial at locations in the U.K. other than Luton. Ref. 456P.
(3) ELECTRONIC Trials Assistants.
SUCCESSFUL applicants will become members of trials teams under the leadership of Electronic Trials Engineers and will be required to assist in the installation and subsequent trial of H.F. communication equipment. Ref. 456R.
(4) ELECTRONIC Laboratory Assistants.
APPLICANTS should have experience of the preparation (from circuit diagrams) of information for the drawing office and production departments Ref. 1066D.
(5) RADAR Assistants.
APPLICANTS will be required to assist senior radar engineers in the operation, maintenance and modification of experimental radar systems in the field. Ref. 1190B.
(6) ELECTRONIC Laboratory Assistants (Trials).
APPLICANTS should have experience of the preparation of radar equipment for field trials, for which a sound basic knowledge of radar circuitry is essential, and special knowledge of radar equipment A.A. No. 3 Mk. 7 would be an advantage. Ref. 1066E.
SALARIES are appropriate to the qualifications and experience necessary for the various positions which are permanent and progressive. A staff pension scheme operates and housing assistance will be provided for suitable applicants for posts (1), (2), (3) and (6).—Applications to Dept. C.P.S., 336/7, Strand, W.C.2, and quoting appropriate reference number. [2123

ELECTRONIC engineers are required by the G.E.C. Stanmore Laboratories, Brown's Lane Division, for work in their development laboratories in the following fields:—
1. SERVO-mechanisms and magnetic amplifiers.
2. MICROWAVE circuits.
3. PULSE circuits.
4. GENERAL radar circuits and C.R.T. radar presentation.
5. PREPARATION of G.W. equipments for trials.
6. STABILISED radar aerials.
APPLICANTS should be experienced in at least one of the above fields, and also for preference should have a minimum of two years' experience in the development of equipment for the Services; degree or equivalent desirable, but not essential; the situations vacant are for permanent staff with good salaries for the right men.—Reply to the Personnel Manager (Ref. WW/MW), "The Grove," Stanmore Common, Stanmore, Middlesex, stating age, qualifications and experience. [2145

ELECTRONIC engineers required by The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry, in their development laboratories for work on:—
(a) TRIALS team in connection with guided weapons; 1 senior engineer, also 3 engineers.
(b) SERVO-MECHANISMS; 1 engineer.
(c) PULSE circuitry; 3 engineers.
(d) MICROWAVE circuits; engineer.
(e) TEST equipment; 2 engineers.
(f) GENERAL radar circuit development; 2 engineers.
(g) POWER units, including electronic stabilisers and rectifier systems; 1 engineer.
(h) MAGNETIC amplifiers; 1 engineer.
APPLICANTS, preferably with a degree or an equivalent qualification should have had at least two years experience in the development and engineering of service equipment as well as experience in one of the above.
HOUSES on the outskirts of Coventry, near our laboratories, are now available for offer to successful applicants and this offer can only remain open for a few months; reply, stating age, qualifications and experience to the Personnel Manager, Ref. R.G. [2163

A VACANCY exists in the production department of a large radio manufacturing company for a young man, aged about 25 years, with B.Sc. degree or equivalent qualification; position offers good prospects of advancement to one who can prove his abilities.—Applicants should write, stating age and details of education and experience, to Box F.119, Willing's, 362, Grays Inn Rd., London, W.C.1. [2065

DRAUGHTSMEN are required for development work on high priority electronic test equipment; the work is interesting and offers considerable scope for men with initiative; attractive salaries in excess of the A.E.S.D. rates will be offered to suitable applicants.—Write giving details of past experience to The Wayne Kerr Laboratories, Ltd., Sycamore Grove, New Malden, Surrey. [2161

ELECTRONIC Engineer with practical experience in industrial applications and good technical knowledge is required by a large food organisation centred in London, for the development, design and construction of electronic equipment. Applicants should have initiative and be resourceful. Post will be of supervisory grade and salary according to age and experience.—Apply Box 2122. [2169

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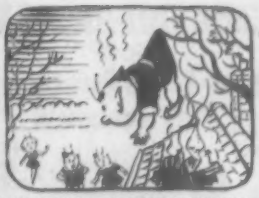

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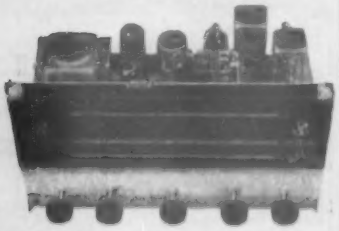

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INSPECTOR must have held A.I.D. approval, & conversant with aircraft wiring and electro-mechanical control gear (N. London); state age, exp., salary reqd.—Box 2511. [2241

SENIOR and junior development engineers wanted for radio and television laboratory. —Write giving full details of past experience to Masteradio, Ltd., 10/30, Fitzroy Pl., W.W.1. [2178

A VACANCY occurs in the design laboratory of manufacturers in the Glasgow area for engineer with experience of development work on radio or electronic equipment; salary £500-£600.—Box 2025. [2130

RADIO service mechanics required by Smiths (Radiomobile), Ltd., for all parts of the country.—Write details of experience and qualifications to Personnel Officer, Goodwood Works, North Circular Rd., London, N.W.2. [2342

McMICHAEL RADIO, Ltd., require experienced radio technicians for the inspection, testing and servicing of Government radio and electronic equipment.—Apply to Personnel Manager, Waltham Rd., Slough, Bucks. [2129

DRAUGHTSMAN, senior, intermediate and junior are required by A.T. & E. (Bridgnorth), Ltd., in their mechanical development and drawing offices; experience in one of the following fields is preferable:—ELECTRO-MECHANICAL devices, light engineering, radar, radio, electronic circuitry. KNOWLEDGE of workshop practice also O.N.C. advantageous. POSITIONS are permanent and progressive; attractive superannuation scheme; five-day week. APPLICATIONS stating age, experience and salary required should be addressed to: Chief Engineer, A.T. & E. (Bridgnorth), Ltd., Bridgnorth, Shropshire. [1957

A.T. & E. (BRIDGNORTH), Ltd., a subsidiary of Automatic Telephone & Electric Co., Ltd., have a number of vacancies for senior and junior electronic engineers in their development and engineering laboratories. APPLICATIONS are invited from engineers having experience in the following fields:—(a) VHF/UHF radio telephone techniques. (b) BROAD band (multi-channel) radio systems. (c) UHF measuring equipments. (d) ELECTRONIC instruments (general). (e) EQUIPMENT engineering allied to electronics. POSITIONS are permanent and progressive for those with suitable qualifications and experience; there is an attractive superannuation scheme and a five-day week. APPLICATIONS, stating age, experience and salary required, should be addressed to Chief Engineer, A. T. & E. (Bridgnorth), Ltd., Bridgnorth, Shropshire. [1958

CAPACITOR technician required for process engineering of paper dielectric capacitors. —Apply in writing, giving full details, to A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garratt Lane, S.W.18. [2073

DEVELOPMENT Engineer required to work on television aerials, capable of conducting tests and supplying graphical interpretations, without supervision.—Write giving fullest details Box 1690. [2077

CANADA.—Experienced television repair technician required for large department store; commencing salary $70 per week for fully qualified man; applicants to state age, experience, etc.—Box No. 2108. [2158

FULLY conversant technical salesman required for leading radio and TV components parts shop in commercial and M.o.S. goods, in city of Birmingham; state wages and full particulars.—Box 2194. [2186

RADIO and television engineer required for old-established firm, high wages and permanent position for suitable applicant; all applications considered.—Apply A. Hartill & Sons, Ltd., 6-12, Mount Pleasant, Bilston, Staffordshire. [2152

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus, also instrument makers, wirers and assemblers, for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts. [0258

RADIO and television engineers of all grades required for new service factory in East London.—Please write in first instance, giving details of past experience and salary required, to Leytonia Radio, Ltd., Service Department, 526, High Rd., Leyton, E.10. [1969

TEST set mechanic required for construction and maintenance of test equipment; good knowledge of radio circuits essential.—Write to: Personnel Manager, Standard Telephones and Cables, Ltd., Dowlish Ford Mills, Ilminster, Somerset. [1989

X-RAY service technician required for London and the Home Counties; practical experience with X-ray apparatus essential.—Write, giving details of age, experience and salary required, to Watson & Sons (Electro-Medical), Ltd., East Lane, North Wembley. [2070

ELECTRONIC engineers for senior positions in nucleonic instrument design; also physicist with nuclear physics experience; required for posts in Electronics Division, E. K. Cole, Ltd., Southend-on-Sea, Essex.—Apply in writing to Personnel Manager. [2091

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PLEASE write in detail quoting reference of post sought to Personnel Manager, de Havilland Propellers, Ltd., Hatfield, Herts. [2151

TELEVISION Engineer required by leading radio and television dealers for servicing department at Halesowen, Birmingham. Must be fully qualified. Good salary and prospects for advancement.—Write giving full details of experience age, etc., to Box 1701. [2090

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RADIO and radar testers, first-class men required for work on V.H.F. communication gear and Government contracts for radio and radar equipment by Midland manufacturers.—Men with wide experience of fault finding in any of the fields mentioned should write, giving full details, to Box 1562. [2046

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PHYSICIST for development laboratory in Northamptonshire. Applicant would be required to control a pilot plant producing various materials used in the radar industries. Experience of microwaves desirable but not essential. Salary will depend on age, qualifications and experience.—Box 2070. [2138

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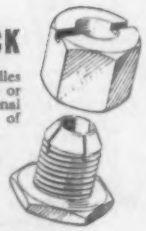

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SITUATIONS VACANT

A SENIOR engineer is required for television receiver development; experience in this field is essential, and applicants should be capable of undertaking circuit development for mass production.—Applications giving age, qualifications and experience, to Baird Television, Ltd., Development Laboratory, Lancelot Rd., Wembley, Middx. [2155

ELECTRONIC engineer with degree or H.N.C. and with several years' experience is required for work on under water acoustics.—Apply in writing to Staff Manager (Ref. RLO/13), Research Laboratories, The General Electric Co., Ltd., North Wembley, Middx, giving full details of age, qualifications and experience. [2159

EXPERIMENTAL Physicist reqd. for an advanced development section, to investigate a variety of problems arising in the study phase of development of electronic devices. Applicants should have a good degree, and preferably post-graduate experience.—Please write with full details to Personnel Dept. (ED/148) E.M.I. Eng. Dev., Ltd., Hayes, Middx. [2166

THE M.S.S. Recording Co., Ltd., Poyle Close, Colnbrook, Bucks, have a vacancy for a technical assistant required for electronic development work on magnetic recording equipment; practical experience or knowledge of mechanical design an advantage.—Apply in writing, stating age, qualifications and experience, to the above address. [2192

TRANSFORMER designer required, an excellent opportunity exists for an engineer with thorough experience of radio mains transformer and radio transformer design.—Applications, which will be treated in strict confidence, should be addressed to the Personnel Manager, Murphy Radio, Ltd., Welwyn Garden City, Herts. [2185

ELECTRONIC engineers to inspect and service AA radar and electronic fire control equipment. O.N.C. or equivalent qualifications necessary. Salary £550 (age 28 or over) + £20 to £628 (London). Generous paid annual leave, emp.oyment at locations within the London, Home Counties and North and South Thames areas.
APPLICATION forms from:—O.C., No. 1 Maintenance Unit R.A. Veterinary Lines Shrapnel Barracks, Woolwich, S.E.18. [2202

DRAUGHTSMEN required. Electronic instrument, or radio experience. Salary according to qualifications. Saturday interview if required. Opportunity to broaden experience with reputable firm. Near City centre and all amenities. Within easy access of London.—Marconi Instruments, Ltd., Longacres, Hatfield Rd., St. Albans. [2209

SENIOR resistor engineer to take managerial responsibility for a factory producing vitreous enamelled wire-wound resistors; preference will be given to applicants having specialist experience in this field.—Write in the first instance giving full details of relevant experience to Labgear (Cambridge), Ltd., Willow Place Cambridge. [2226

ENGINEER or Physicist with experience of problems associated with the design of electronic tubes is required for interesting development work in this field. Applicants should have a degree in physics or equivalent qualifications. Vacancies also exist for assistants.—Please write with full details to Personnel Dept., quoting ED/126, E.M.I. Engineering Development, Ltd., Blyth Rd., Hayes, Middx. [2131

DRAWING office staff required, draughtsmen and drawing office clerk, to take charge of print room and drawing office records, for a well-established firm, situated within half an hour of Waterloo Station; draughtsmen should have workshop experience and preferably a knowledge of electronics; good salary paid to suitable applicants; 5-day week.—Apply D.O., Box 1709, 15, Hill St., London, W.1. [0246

ENGINEERS required for (a) maintenance and design of electronic test equipment, and (b) for quality control and investigational work on radio valves and other electronic devices; Inter B.Sc. or Higher National Certificate standard.—Write, giving experience and salary required, to Personnel Superintendent, The Edison Swan Electric Co., Ltd., Cosmos Works, Brimsdown, Enfield, Middlesex. [1966

THE ENGLISH ELECTRIC Co., Ltd., Luton, have a vacancy for a technical author for the preparation of manuals and handbooks covering electronic and/or mechanical equipment associated with guided weapons; housing assistance can be given to suitable applicant from the Greater London area.—Applications to Dept. C.P.S., 536-7, Strand, W.C.2, quoting Ref. 1155A. [2065

FERRANTI, Ltd. (Hollinwood) have vacancies for Technical Assistants in the high voltage laboratory of their transformer department. The work involves participation in the general work of the surge testing section together with some work in the development of electronic test equipment. Applicants should be of approximately graduate status with some practical experience in electronics.
PERMANENT staff appointments with pension benefits.
APPLICATION forms from Mr. R. J. Hilbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs.
PLEASE quote reference LP. [2079

ASSISTANT electronic engineer required for design and construction of wide range of test apparatus used in connection with instrumentation of aircraft and test rigs. Applicants must have a sound theoretical knowledge up to at least H.N.C. standard and practical experience in above or similar fields is desirable.—Write, stating age and full details to Staff Officer, Handley Page, Ltd., Cricklewood, N.W.2 [2117

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ELECTRONIC engineers required for research and development work on the application of electronic digital computing techniques to business accounting machines; there are vacancies for the following:—
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(ii) ENGINEERS holding Higher National Cert., Ordinary National Cert., or similar qualifications, and with practical experience of electronic equipment.
APPLICANTS without academic qualifications would be considered if they have had experience of electronic equipment, preferably of pulse techniques as used in digital computing, radar, etc.; salaries will be based on qualifications, experience and age.—Applications, stating age, qualifications, experience, etc., to Personnel Office, British Tabulating Machine Co., Letchworth, Herts. [2142

WEST London engineering firm, soon moving to Bracknell, Berks, invites applications from British subjects for work on defence projects. Engineers and draughtsmen are required to fill vacancies under the following headings.
SENIOR Engineers. Applicants should possess recognised professional qualifications and be experienced in various aspects of the design of airborne radio/radar/navigation systems. Administrative ability essential.
ENGINEERS. Recognised qualifications and/or exceptionally wide practical experience of airborne radio/radar systems. Knowledge of A.I.D. requirements an advantage.
DRAUGHTSMEN. Experienced electro-mechnical design draughtsmen for work on systems outlined above.
HOUSING accommodation will be available for selected applicants. Salary commensurate with qualifications and experience. Full personal details should be forwarded with applications to Box 1728. [2084

JUNIOR test assistant with some telecommunication knowledge required by company S.E.10; a young man studying for City and Guilds telecommunications course in engineering would be considered; experience of cable test at audio and carrier frequencies desirable but not essential; all welfare facilities; 5-day week; salary according to age and qualifications.—Apply Staff Officer, Telcon Works, Greenwich, S.E.10.

SENIOR and junior engineers required for responsible work in radio and television laboratories, applicants for senior position should be able to undertake development work with minimum supervision; excellent conditions and salary available for applicants who are accepted.—Apply in first case to Personnel Manager (Dept. R.D.), McMichael Radio, Ltd., Wexham Rd., Slough. Applicants must be of British nationality. [2021

THE ENGLISH ELECTRIC Co., Ltd., Luton, have a vacancy for a designer of low power (up to 1kw) low frequency transformers and chokes; previous experience very desirable and applicant should be thoroughly familiar with winding and impregnation processes; varied interesting work, involving development of a number of designs for small quantities.—Applications to Dept. C.P.S., 356-7, Strand, W.C.2, quoting Ref. 1137A. [2064

THE ENGLISH ELECTRIC Co., Ltd., Luton, require technical assistants for vibration and shock investigations on guided missiles, previous experience unnecessary, a working knowledge of electronics required together with education to O.N.C. or equivalent standard, varied and interesting work with good prospects.—Write stating age, qualifications and experience to Dept. C.P.S., 356-7, Strand, W.C.2, quoting reference 1000C. [2190

PRODUCTION manager required for radio factory in Southern Rhodesia; applicants, preferably single, must have several years experience in similar capacity, and be capable of production lay-out, time study and overall technical supervision; commencing salary £110 per month; air passage will be provided.—Apply direct to Chassay Bros. (Pvt.), Ltd., Supersonic Industries Ingutaheni Road, Light Industrial Sites, Bulawayo, Southern Rhodesia.

BRITISH OVERSEAS AIRWAYS CORPORATION require engineers for the overhaul and maintenance of flight simulators in central training unit near London Airport; applicants should have a thorough knowledge of electronic techniques; practical experience in the maintenance of analog computors, aircraft radio equipment and remote indicating system an advantage; duties:—5-shift system covering 24 hours per day; salary according to qualifications £11/14 to £15/19 per week, plus shift pay (approx. 30/- per week).—Applications to be addressed to Staff Superintendent (Recruitment), B.O.A.C., London Airport, Hounslow, Middlesex. [2154

B.B.C. requires 3 engineers for field strength section of research dept., based Kingswood, Surrey; to carry out experiments involving R/F measurements anywhere in British Isles; must have degree in electrical engineering or physics, or equivalent, with interest in above work and allied problems applicable to broadcasting; experience transmitters, aerials, receivers and knowledge VHF/UHF techniques desirable; starting salary £590 (higher if qualifications exceptional) by 5 annual increments to £900 max.; those not completely fulfilling requirements may be appointed initially at starting salary £500 with increments to £685.—Apply, stating salary required, to E.E.O., London, W.1, within 7 days. [2157

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SITUATIONS VACANT

E. K. COLE, Ltd., Southend-on-Sea, require for their development laboratories, senior and junior engineers, electronic engineers, and a nucleonic physicist; applicants should be experienced in the design and development of either R.F. side of television receivers, car radio or nucleonic instruments and should have degree or equivalent qualification.—Apply stating age, qualifications and experience, to Personnel Manager. [2146

TEST engineers required for specification testing and calibration of a wide variety of medium and high frequency communication transmitters (100W to 10kW) receivers and L.F. amplifiers (250W to 80kW). Permanent posts with salary according to qualifications and experience; 5-day week; canteen facilities; pension scheme.—Write full details to Redifon, Ltd., (Dept. T.), Brownhill Rd., Wandsworth, S.W.18. [2180

MCMICHAEL RADIO, Ltd., require senior and junior engineers in their equipment division laboratory at Slough; training and experience in the field of applied electronics (including communications) and experience of working with Government Departments are the chief qualifications required.—Write, stating age and full details of training, qualifications and experience, to the Chief Engineer, Equipment Division, McMichael Radio, Ltd., Slough, Bucks. [0198

PHYSICISTS and electronic engineers.—Interesting opportunities exist for versatile graduates on the development of transducers and associated electrical/electronic apparatus for measurement of transient and steady state phenomena in precision mechanical engineering projects in West London research dept.—Applicants with suitable education and industrial background please forward full details of education, qualifications, experience, salary required to Box 1799, quoting ref. HPA. [2096

AIR MINISTRY requires Civilian Instructors, Grade III, in the trades of air and ground radar and wireless fitter, for temporary posts, with prospect of permanency, at R.A.F. Radio Schools, Yatesbury (Wilts), Cosford (Staffs) and Locking (Somerset). Qualifications at least 5 years' practical experience and ability to instruct. Trade test before entry. Pay is £480 at 26 rising to £597.—Apply to Air Ministry, 85(G), Cornwall House, Waterloo Rd., London, S.E.1. [2210

SENIOR Mechanical Designers, due to continued expansion two excellent opportunities have arisen in light engineering and electrical fields to deal principally with domestics, radio and television development; the positions which are progressive and permanent, carry salary above average, according to age and experience; practical experience essential; age 26 minimum; pension scheme in operation after qualifying period.—Write, Personnel Manager, Vidor-Burndept, Ltd., Erith, Kent.

YOUNG men with good knowledge of A.C. theory and/or experience in radio, high frequency communication or simmilar fields, required for limited number of vacancies in inspection department of electrical communications engineering organisation in Liverpool; permanent employment offered with good prospects of advancement.—Applicants, who should have completed their military service, should write, giving full details of age and experience, to Box No. 438, Dorland Advertising, Ltd., 18/20, Regent St., London, S.W.1. [2106

FILTER design group of Automatic Telephone & Electric Co., Ltd., Liverpool, has vacancy for engineer to deal with the problems associated with quantity production of electrical wave filters; previous experience in this or similar work is essential, and a degree in engineering or physics is desirable; permanent staff position with contributory pension fund and usual staff conditions.—Write to Personnel Manager, Automatic Telephone & Electric Co., Ltd., Edge Lane, Liverpool 7, giving full details of experience, qualifications and age. [2150

MECHANICAL Engineer required to take charge of mechanical design and development side of electronic and electro-mechanical projects. Applicants should be of degree standard, with experience of electronic equipment, instrument mechanisms or light servo-mechanisms, and be capable of supervising the work of a small drawing office and model shop. Good salary offered by established company opening new laboratories in Surrey. Five-day week. Pension scheme.—Apply with full details of previous experience to Box 1927. [2083

DEVELOPMENT engineer required with at least 7 years experience in research in development and design of light engineering, electronic and mechanical projects, such as magnetic recording, telecommunications and audio frequency equipment; preferably with experience in the supervision of a small group and some outside design liaison with other firms; age 30-35; degree desirable; location South Coast.—Please give full details in first instance stating experience, age and salary required, in confidence to Box 2088. [2147

CHIEF Engineer, microwave link development; Decca Radar Limited is creating an appointment at the rank of chief engineer, to lead a growing division engaged in the development and exploitation of microwave link systems; the successful applicant must have had, in either this or closely allied fields, considerable industrial experience at a senior level; this experience must provide evidence of a faculty for leadership, organising ability and a capacity for drive; British nationality is essential; a starting salary commensurate with the level of the appointment will be paid.—Replies, which will be treated as strictly confidential, should be addressed to the Research Director, 2 Tolworth Rise, Surbiton, Surrey. [0450

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MAINS TRANSFORMERS (NEW), 200/250 volts input in steps of 10 volts, output 0, 6, 12, 24 volts 6 amps, 42/6 each, post 1/6. Another, as above but 10-12 amps, 55/- each, post 1/6; another as above but 25/30 amps, 75/- each, carriage 3/6; another, input as above, output 0/18/30/36 volts 6 amps, 47/6 each, post 1/6.

MAINS TRANSFORMERS (NEW), input 200/250 volts in steps of 10 volts, output 350/0/350 volts, 180 m/amps, 4 volts 4 amps, 5 volts 3 amps, 6.3 volts 4 amps, 45/- each, post 1/6; another 350/0/350 volts 180 m/amps, 6.3 volts 8 amps, 0/4/5 volts 4 amps, 45/- each, post 1/6; another 500/0/500 volts 150 amps, 4 volts 4 amps C.T., 6.3 volts 4 amps, C.T., 5 volts 3 amps, 47/6 each, post 1/6; another 425/0/425 volts 160 m/amps, 6.3 volts 4 amps, C.T. twice 5 volts 3 amps, 47/6, each, post 1/6.

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METERS, Moving Coil, 0 to 14 amps, 18/6 each. Ditto, Moving Iron, suitable for A.C. 0 to 30 amps, 25/- each. Another moving coil, 100 to 250 amps. D.C., 35/- each, all 4in. scale.

12/24 VOLT RECTIFIERS at 4 amps, with suitable Mains Transformer, 200/230 volts input, 55/- each.

MAINS TRANSFORMERS, input 180/250 volts, output 435/0/435 volts, 25 m/amps, 6.3 volts 10 amps 6.3 volts 8 amps, 6.3 volts 8 amps 5 volts 6 amps, 65/- each.

3 KILOWATTS DOUBLE-WOUND VOLTAGE CHANGER TRANSFORMERS, 110/130 volts or vice-versa, as new, weight approx. 100lbs., £12/10/- each, carriage forward.

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D.C. MOTORS, 230 volts, 3 h.p., 3,000 r.p.m. in good condition £3/5/- each; ditto Fan Motors, 230 volts D.C., 20/- each; 110 volts D.C., 17/6 each.

MAINS TRANSFORMERS, input 200/250 volts, output 45/50 volts, 70 amps, suitable for arc welding, £15 each; another 70 volts, 50 amps, £15 each.

WELDER TRANSFORMER, 200/250 v. input, output 0/40/80 volts, 800 amps. Complete, on trolley, £32/10/-, c/fwd.

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The popularity of the chassis mounting electrolytic condenser continues to increase, with the result that we have added this new range, which includes a number of capacity values in current use on the continent of Europe and elsewhere. For the same reason, this new range contains, for the first time, double-section condensers.

"All-aluminium" construction. The condenser elements have high gain etched foil electrodes, consequently overall dimensions are attractively small. Ripple ratings are adequately high at the maximum working temperature of 60°C.

Threaded, moulded boss, through which is brought the positive termination, is the chief feature of these condensers — the can providing the negative connection via the chassis.

Installation. This method saves chassis space and speeds up the wiring-in of the component.

Interchangeability is provided with European types; the boss diameter being ⅜". The standard tolerance of capacity is —20%+50%.

Capacity in μF.	D.C. Volts		Ripple Rating in mA @ 60°C.	Dimensions in Ins.		T.C.C. Type Number	List Price
	Wkg.	Surge		Ht. above Chassis	Dia.		
SINGLE SECTIONS							
25	350	400	150	2 1/16	1	CE170LE	7/6
50	,,	,,	260	3 1/16	1	CE171LE	10/-
16	450	550	120	2 1/16	1	CE170PEA	7/6
25	,,	,,	150	2 1/16	1	CE170PE	8/6
32	,,	,,	210	3 1/16	1	CE171PEA	9/6
50	,,	,,	260	3 1/16	1	CE171PE	11/-
DUAL SECTIONS							
25 - 25	300	350	150	2 1/16	1	CE170KE	10/6
25 - 25	350	400	180	3 1/16	1	CE171LEA	11/-
50 - 50	,,	,,	300	3 1/16	1 1/2	CE172LE	16/-
25 - 25	450	550	180	3 1/16	1	CE171PEB	14/-
50 - 50	,,	,,	310	3 1/16	1 1/8	CE173PE	18/6

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SPECIALISTS IN CONDENSERS SINCE 1906

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meets every requirement of

MANUFACTURERS **SERVICE ENGINEERS** **RADIO ENTHUSIASTS**

7 lb. REELS

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Ersin Flux not only prevents oxidation during soldering but actually cleans surface oxides. 6 alloys and 9 gauges supplied in nominal 7-lb. reels: other alloys and gauges to special order.

Ersin Multicore Solder is made to comply with A.I.D., G.P.O., A.R.B., D.T.D. 599, R.M.S. 1000 and all U.S.A. Federal specifications. The consistently high quality of Ersin Multicore Solder as supplied to manufacturers during the past 14 years, has justified its reputation as "The Finest Cored Solder in the World".

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An economy pack containing approximately 167 feet of 18 s.w.g. 50/50 alloy. Cat. Ref. R.5018 15/- each (subject).

HANDY SIZE 1 CARTONS 5/- EACH

(subject)

4 specifications.

Cat. Ref. No.	Alloy Tin/Lead	S.W.G.	Approx. length per carton
C 16014	60/40	14	21 feet
*C 16018	60/40	18	55 feet
C 14013	40/60	13	19 feet
C 14016	40/60	16	38 feet

** Specially recommended for television.*

Also available in 6d. cartons containing approx. 3 feet 40/60 Alloy 16 s.w.g

Special MULTICORE products for specific uses

MULTICORE TAPE SOLDER

A real tin/lead solder containing cores of Ersin Flux. Melts with a match. Available to manufacturers in 3¼ lb. reels.

LIQUID FLUXES

For dipping purposes or other processes where it is not convenient to use Ersin Multicore Solder, Ersin non-corrosive Flux is available in liquid form.

ULTRA-FINE GAUGES

16 s.w.g. 98 ft. per lb. | 22 s.w.g. 512 ft. per lb. | 34 s.w.g. 5,040 ft. per lb.

Yes, the 34 s.w.g. does contain 3 cores of flux!

Ersin Multicore Solder can be supplied in 1 lb. reels to Manufacturers in as fine a gauge as 22 s.w.g., and on ½-lb. reels in even gauges between 24 and 34 s.w.g.

ERSIN NON-CORROSIVE JELLY FLUX

A separate flux of the Ersin type with a high viscosity consistency, Ersin Jelly Flux satisfies A.I.D. requirements for a halide content of the D.T.D. 599 specification.

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SPECIAL HIGH AND LOW MELTING POINT ALLOYS

Type	Melting point
T.L.C.	145°C
L.M.P. ALLOY (with 2% silver content)	179°C
P.T.	232°C
COMSOL (Tin/Lead/Silver)	296°C

Solder Rings

at no extra cost!

Butt-jointed solder rings in Ersin Multicore Solder Wire or Precision Made Solid Solder Wire can be supplied in bulk quantities. The only cost involved is that of the solder, according to the alloy and gauge required. Gauges—dependant upon the diameters specified—cover the range from 10 to 22 s.w.g. Other preforms available to special order.

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